An Analysis of the Pennsylvania Farm Conservation Practices Inventory for Purposes of Reporting Practices to the Chesapeake Bay Program

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Executive Summary

A survey of Pennsylvania farmers in the Chesapeake Bay watershed was conducted to provide them an opportunity to self-report conservation practices implemented on their farms. The survey especially sought data on "voluntary," non-cost shared practices. The survey instrument and procedures were developed in collaboration by survey research experts in Penn State's Survey Research Center, and subject matter experts from state agencies and agriculture. The survey development and implementation process was led and managed by the Agriculture and Environment Center (AEC), Penn State University, College of Agricultural Sciences.

The survey was mailed to approximately 20,000 farmers in late January 2016, with returns accepted until the end of April 2016. A total of 6,782 were completed and returned.

To assess the reliability of the self-reporting, approximately 10 percent of returns were selected randomly for on-farm verifications conducted by trained and experienced Penn State Extension staff. Statistical analyses of the data reject systematic under or over reporting in the sample data for the majority of relevant conservation practices, but means and 95% confidence intervals reveal a trend toward under reporting for the vast majority of practices. For several of these practices our analysis reveals a systematic under reporting by farmers. These include pasture acres in nutrient management plans, dairy manure storages, barnyard runoff controls, and stream bank fencing. Systematic over reporting was detected in only one practice, riparian buffers. We believe the cause of over reporting for riparian buffers was a difference between how the survey questions were asked for stream bank fencing and riparian buffers and how Penn State Extension agents were trained to record these practices during farm visits. In the case of riparian buffers, adjustments can be made to remove the resulting bias.

In order to ensure the numbers provided to the Commonwealth for reporting to the Chesapeake Bay model eliminate any potential for over reporting, we recommend applying our statistical analysis to adjust only for systematic over reporting of riparian buffers, and not for the other practices where systematic under reporting was evident. With this adjustment, farmers responding to the survey have implemented the following non-cost shared and/or previously unreported practices: 475,800 acres of nutrient/manure management; 97,562 acres of enhanced nutrient management; 2,164 animal waste storage units; 2,106 barnyard runoff control systems; 55,073 acres of agricultural E&S plans; 228,264 acres of conservation plans; 1,336,100 linear feet of stream bank fencing; 1,757 acres of grass riparian buffers; and 5,808 acres of forest riparian buffers.

Introduction

There is much interest in the extent of the use of water quality protection practices in Pennsylvania agriculture. Conservation practice adoption is well-documented for practices that are implemented with federal or state financial assistance. Yet, while it is known that farmers adopt water quality protection practices without public financial support, there is no systematic accounting for these investments. In consequence, these self-financed practices are not accounted for in tracking the progress towards water quality goals, including cleaning up the Chesapeake Bay.

There are several initiatives that have been implemented to address this data gap. Here we report on the results of a sample survey of water quality practice adoption by Pennsylvania farmers located in the Chesapeake Bay watershed conducted early in 2016. The survey was conducted by the Penn State Agriculture and Environment Center with funding from the Pennsylvania Department of Environmental Protection (DEP), and with collaboration from the Pennsylvania Farm Bureau, Penn Ag Industries, Professional Dairy Managers of Pennsylvania, the Pennsylvania Department of Agriculture, the Pennsylvania State Conservation Commission, Pennsylvania Association of Conservation Districts, and Penn State Extension. The survey was designed specifically to provide data on self-funded high priority practices.

Survey Methodology

The survey instrument was developed by a set of topic experts with technical assistance from the Penn State Survey Research Center (SRC). The survey asks questions to determine the use of a set of priority conservation practices, the funding sources for the practices, and farm operation characteristics. To control the length and complexity of the survey, the set of practices addressed in the survey was limited to the following practices that provide high levels of nutrient and sediment reductions, are practices accepted by the Chesapeake Bay Program for credit toward meeting nutrient and sediment load allocations, and are likely to have high levels of voluntary adoption:

Nutrient/manure management plans
Enhanced nutrient management
Manure transport
Animal waste storage systems
Barnyard runoff controls
Agricultural E&S plans and conservation plans
No till and minimum till
Cover crops
Stream bank fencing
Riparian buffers

Questions determine whether the practices are present on a farm, and if so, determine the level of implementation using units compatible with the Chesapeake Bay model, the funding source, and whether they meet definitions acceptable to the Chesapeake Bay Program. A copy of the survey instrument is provided in Appendix A.

The survey was mailed by the SRC to approximately 20,000 potential respondents located in the Chesapeake Bay watershed in Pennsylvania in January 2016. The sample frame was provided by Penn State Extension and was gathered from Extension's extensive statewide programming for farmers. The mailing included a letter from Pennsylvania Secretary of Agriculture Russell Redding, Dean Richard Roush of the Penn State College of Agricultural Sciences, and Richard Ebert, President of Pennsylvania Farm Bureau, inviting farmers to respond, explaining the reasons for and the importance of the survey, describing the uses of the data, and describing data management procedures that assured the confidentiality of farmers' responses.

Respondents were provided both web and mail options for returning the survey. Postcard reminders and a second copy of the survey were mailed to non-respondents during the survey period. The survey closed April 30, 2016.

To help boost response rates, partnering farm and agency organizations promoted the survey at winter farmer meetings and other events, through periodic press releases, in publications such as Lancaster Farming, and within their memberships.

The SRC accepted all returns via business reply envelopes and website and processed all returns. Returns were checked for duplicates, machine scanned and coded by the SRC. In its administration of the survey, the SRC assigned a unique ID number to each respondent. The SRC retained as confidential all data which links the ID numbers to names and addresses of respondents. A total of 6,782 individual survey returns were received and processed. The returns were analyzed to determine conservation practices implemented by respondents. Results are reported cumulatively in aggregate in this report and can also be reported cumulatively by county, the Commonwealth's preferred method for reporting BMP implementation data to the Chesapeake Bay Program.

Farm Visit Verification Methodology

Reported BMPs may differ from actual BMPs for various reasons. In order to assess the reliability of the results, a subsample of 10% of the respondents was randomly selected for farm visits by Penn State Extension agents. Given DEP's preference for reporting results by county, the subsample was drawn by taking a random sample of 10% of the responses in each of the sampled counties. The on-farm visits were conducted by 42 Penn State Extension Agents with expertise in relevant disciplines such as agronomy, livestock operations, nutrient management, horticulture and cropping systems, and extensive experience working with farmers.

Participating agents were trained by staff from DEP, PA State Conservation Commission, Chesapeake Bay Program and the Lancaster County Conservation District. The trainings provided information on biosecurity protocols, overviews of the survey and the farm visit form to be used during farm visits, and information on how to use DEP checklists for determining the existence of manure management plans and agricultural E&S plans and Chesapeake Bay Program Resource Improvement (RI) practice standards for applicable structural BMPs.

Farm visits were conducted in August and September 2016. Agents were assigned farmers from the subsample. The agents were responsible for setting up the visits with participating farmers. The

instructions for the survey indicated the possibility that respondents might be chosen for a farm visit, which limited surprise and maximized farmer cooperation in agreeing to host farm visits. Agents contacted the farmers chosen for visits by letter and by phone to schedule visits. Consistent with the confidentiality of the survey responses and to eliminate potentials for bias, the agents were not provided participating farmers' survey responses. A total of 711 farms were visited, 10.48% of the total population of respondents.

A form was developed by the survey development team for use by the agents to record their findings. The questions mirrored those asked on the survey about the presence and extent of practices, but additional information was sought in the visits to determine whether the practices were installed and functioning sufficient to meet Bay Program standards. Specifically, the agents were trained on the visual indicators for meeting RI practice standards for applicable structural best management practices. If these indicators were not met, the practice was not counted. Extension agents were also trained on the essential substantive elements of manure management plans and agricultural E&S Plans. If the farmer was not able to produce a plan and the plan did not contain these essential elements, it was not counted. A copy of the farm visit report form is provided in Appendix B.

The completed farm visit reports were submitted by the agents to the AEC data analysis team for coding. Unique ID numbers on the farm visit reports allowed researchers to link each farm visit report with the corresponding farm survey responses, and systematically compare the answers as described more fully in the next section.

Reliability Data Analysis

The reliability analysis involves comparison of the conservation practices reported by survey respondents selected for the 10% subsample with the implemented practices recorded in the farm visits. For the analysis, the difference between the "reported" values from the farm survey and the "verified" value from the farm visits is computed for each practice. Systematic under reporting or over reporting of BMP types can be determined statistically by testing whether the mean of the differences across farms for the BMP type is not significantly different than zero. We look at the overall mean to make this determination, but we also break down the analysis according to how much of the sample falls into the following categories:

	0 (acres) indicated in the farm visit report	> 0 (acres) indicated in the farm visit report
0 (acres) indicated in the original mail/web survey	Category 0	Category 2
> 0 (acres) indicated in the original mail/web survey	Category 1	Category 3

This breakdown is intended to supplement the analysis of the overall mean differences. Response pairs in categories 1 and 2 represent qualitative errors, whereas category 3 could more likely represent a quantitative error. Ultimately we believe it makes the most sense to base our conclusions of bias on the overall mean differences, but it is interesting to note the proportion of farms that fall into these four categories for the various BMPs. Our analysis is summarized in Appendix C ("BMP Survey Verification Summary").

In addition to the analysis of means, histograms are presented for each practice to give a visual representation of the distribution of the "difference" variables. In some cases, dropping one or two observations has a large impact on the means and variances. We show results for the summary statistics both with and without some of these outliers, but the histograms exclude these outliers. (See Appendix C).

By way of example, Figures 1 and 2 are histograms for acres of row crops under nutrient management plans and number of barnyard runoff control systems, respectively. All other histograms are provided in Appendix C.

Figure 1. Histogram plotting mean differences between reported and verified acres of row crops under nutrient management.

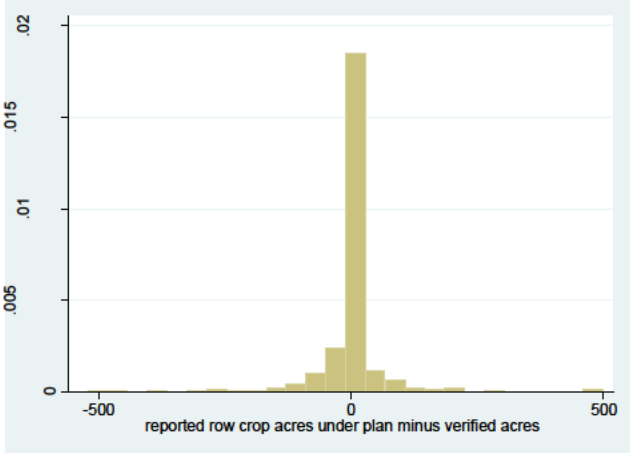
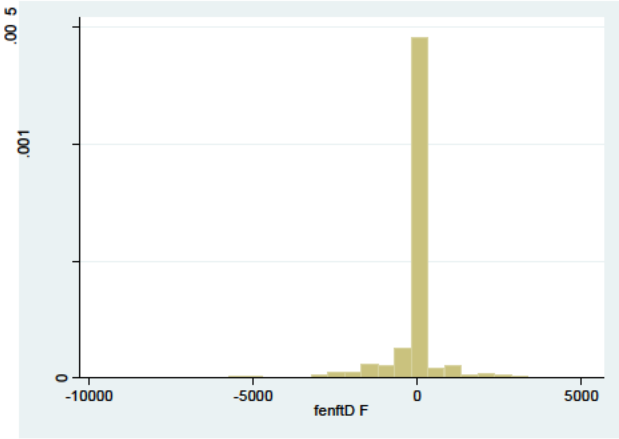


Figure 2. Histogram plotting mean differences between reported and verified linear feet of stream bank fencing.



For each conservation practice analyzed, several sources of data from the survey and the farm visits were used to determine "reported" and "verified" values. These sources, and specifically how they relate to particular survey questions in the original survey and the farm visit report, are described for each practice in Appendix C.

Results

Statistical analysis of the survey data compared to farm visit data in the aggregate reveals a statistically significant reliability in the data for all conservation practices for which the Commonwealth seeks to use these survey results to report newly documented practices to the Chesapeake Bay Program. These include:

Nutrient/manure management plans
Enhanced nutrient management
Animal waste storage systems
Barnyard runoff controls
Agricultural E&S plans and conservation plans
Stream bank fencing
Riparian buffers

For all of these practices, cumulative results are reported in the aggregate with associated means and 95% confidence intervals.

Another practice, manure transport, did not have a large enough subsample to analyze for statistical accuracy. Accordingly, raw data numbers documenting manure transport between counties are provided without associated means and 95% confidence intervals.

For all of these practices, data was analyzed to ensure practices met relevant standards and definitions under the Chesapeake Bay Program and to ensure certain practices were not double counted. For example, only those practices for which the farmer indicated that no government cost share funding was utilized were reported. The only exceptions to this are manure management plans and agricultural E&S plans, for which there is currently no documented reporting even if cost share is provided for plan development.

Table 1 is a summary of all cumulative results of relevant practices eligible for reporting to the Chesapeake Bay Program, with the exception of manure transport.

Table 1. Cumulative results by conservation practice from reported farm surveys

Practice	Amount Implemented			
Nutrient/manure management plans[1]	335,250 ac row crops	37,243 ac pasture	103,307 ac hay	
Enhanced nutrient management	97,562 ac			
Animal Waste Management Storages	1,598 dairy units	194 beef units	213 swine units	159 poultry units
Barnyard Runoff Controls	2,106 systems			
Agricultural E&S plans	40,170 ac row crops	4,930 ac pasture	9,973 ac hay	
Conservation plans	173,481 ac row crops	17,239 ac pasture	37,544 ac hay	
Stream bank fencing	1,336,100 linear feet			
Watercourse Access Controls[2]	Grass 10-35 ft width: 324 ac	Grass >35 ft width: 471 ac		
Riparian buffers	Grass 10-35 ft width: 455 ac	Grass >35 ft width: 826 ac	Forest 10-35 ft width: 1,131 ac	Forest >35 ft width: 6,601 ac

Manure transport numbers are reported as annual tons or gallons of manure by type transported from one county to another. The survey data allows us to report manure transport by county of origin and designation, and by specific manure type (dairy, beef, swine or poultry), and whether the farmer worked with a manure hauler or broker. Counties importing and/or exporting manure and the net change in manure from these reported activities are provided in Appendix D, expressed in tons, where all reported liquid gallons were converted to tons using Penn State Extension's recommended conversion factor.

Figure 3 shows Chesapeake Bay counties exporting manure to another county. Figure 4 shows counties importing manure from a Bay county. Note that Jefferson County (NY), which is outside of the Bay watershed, does not appear on the map but received 2000 tons of poultry manure from Lancaster County.

[1] Here we report non-cost shared nutrient management plans and all manure management plans in the aggregate. However, since Act 38 and 590 nutrient management plans are sufficiently tracked and reported through regulatory programs in the Commonwealth, we plan to net these out of the final data set reported to avoid double counting.

[2] Because the survey did not ask farmers to specify vegetation type inside stream bank fencing, we assume the watercourse access control buffer area is grass for all acres reported.

Figure 3: Counties exporting manure (in tons)

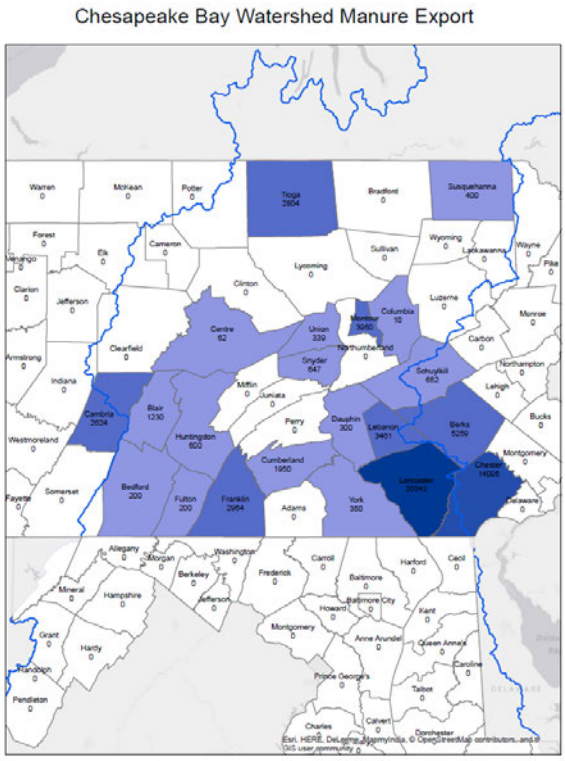
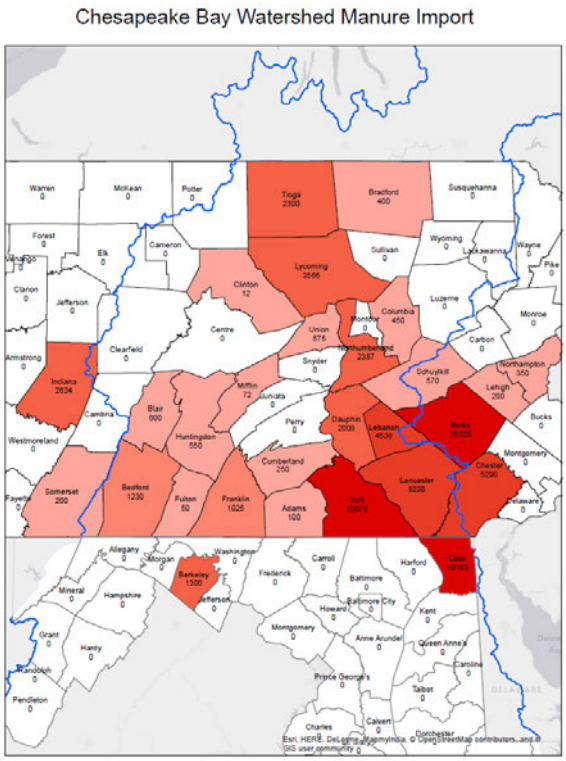


Figure 4: Counties importing manure (in tons)



Discussion

For all results of practices reported cumulatively in Table 1, means and 95% confidence intervals were developed. These were calculated following the reliability data analysis methods described above. For all practices except riparian buffers, the 95% confidence interval either straddles the reported number, or the lower and upper bound and the mean is higher than the reported number, indicating a trend toward under reporting by farmers.

With respect to riparian buffers, the mean is lower than the reported number as is the lower and upper bound of the 95% confidence interval, indicating a systematic over reporting by farmers. While the data does not definitively indicate the reason for this, we believe it may be caused, not by actual over reporting by farmers, but rather by differences between how the farm survey questions were asked with respect to stream bank fencing and riparian buffers and how Extension agents were trained in verifying buffers during farm visits. The questions on the survey related to riparian buffers were designed to have farmers report *all* acres of buffers in answer to the riparian buffer question, including those acres resulting from stream bank fencing. In contrast, Extension agents were trained on Resource Improvement practices RI-4a, 4b, 5, 6 and RI-7, 8, 9, 10 and were instructed to record watercourse access controls in response to the stream bank fencing question, and other buffers not requiring livestock access controls in response to the riparian buffer question. This may have led farmers to report all buffer acres in response to the riparian buffer question, while Extension agents did not record any buffer acres resulting from stream bank fencing in response to that same question.

Because the data on riparian buffers reveals a statistically significant over reporting, adjustment of the numbers downward using the mean is warranted to account for this over reporting. This would adjust the total of 9,013 reported acres to 6,770 reported acres, with corresponding adjustments to the buffer categories reported based on width and vegetation. These adjustments were calculated as follows: reported value – (mean deviation per farm)n, where n = total number of farms with survey returns (6,782). See Appendix E for details on this calculation.

In addition, adjustments can be made to all reported practices using the mean deviation between reported and verified practices for each practice, to account for systematic under or over reporting as revealed by the data analysis. Again, this can be computed for each practice as follows: reported value – (mean deviation per farm)n, where n = total number of farms returning surveys (6,782). Lower and upper 95% confidence bounds on this number can also be calculated in similar fashion using the two ends of the 95% confidence intervals developed for each practice. See Appendix E for a sample calculation (using riparian buffers) to demonstrate how these numbers were achieved.

Table 2 displays the cumulative results for each conservation practice, the adjusted cumulative number using the calculation described above (which we classify as the "expected" results), and the lower and upper bounds of the 95% confidence interval applied to the cumulative results.

Table 2. Cumulative reported results and expected (adjusted) cumulative results by conservation practice, bounded by 95% confidence lower and upper bounds as applied to the cumulative results.

Practice	Reported Results	Lower 95% Bound	Expected Results	Upper 95% Bound
Nutrient Management Plans	335,250 ac row crops 37,243 ac pasture 103,307 ac hay	316,193 ac row crops 16,693 ac pasture 92,795 ac hay	350,103 ac row crops 40,769 ac pasture 115,514 ac hay	384,081 ac row crops 64,845 ac pasture 138,234 ac hay
Enhanced Nutrient Mgt	97,562 ac	38,898 ac	82,303 ac	123,640 ac
Animal Waste Management Storages	1,598 dairy 194 beef 213 swine 159 poultry	1,879 dairy 174 beef 193 swine 130 poultry	2,113 dairy 299 beef 318 swine 207 poultry	2,347 dairy 425 beef 444 swine 284 poultry
Barnyard Runoff Controls	2,106 systems	2,139 systems	2,364 systems	2,588 systems
Agricultural E&S Plans	40,170 ac row crops 4,930 ac pasture 9,973 ac hay	28,437 ac row crops 4,455 ac pasture 13,907 ac hay	60,380 ac row crops 13,068 ac pasture 26,521 ac hay	92,323 ac row crops 21,749 ac pasture 39,136 ac hay
Conservation Plans	173,481 ac row crops 17,239 ac pasture 37,544 ac hay	104,372 ac row crops 15,883 ac pasture 42,224 ac hay	229,636 ac row crops 23,818 ac pasture 59,450 ac hay	354,831 ac row crops 31,685 ac pasture 76,608 ac hay
Stream Bank Fencing	1,336,100 linear feet	1,590,818 linear feet	2,293,651 linear feet	2,996,483 linear feet
Watercourse Access Control	795 ac	867 ac	1730 ac	2591 ac
Riparian Buffers	9,013 ac	4,823 ac	6,770 ac	8,716 ac

Figures 5 through 13 display the reported cumulative results for each conservation practice compared to the mean with the 95% confidence interval applied as an upper and lower range on the data. For each graph, blue bars display the reported values from the survey, while the magenta bars are the expected values based on means with error bars showing the range of the 95% confidence interval.

We note that nutrient and manure management plans are reported here in the aggregate, but Act 38 and 590 nutrient management plans, which are sufficiently tracked and reported through regulatory programs in the Commonwealth, can be netted out from the final set of data reported to avoid double counting.

Figure 5. Nutrient Management Plans: reported (blue) v. expected (magenta) results with 95% confidence intervals

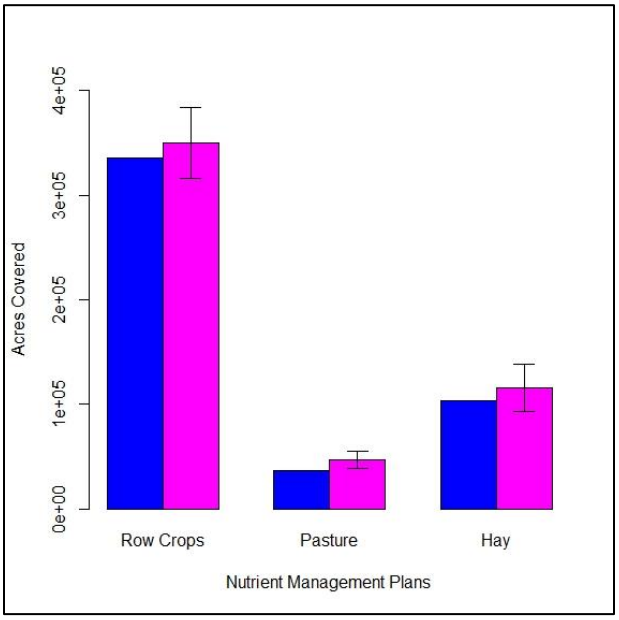


Figure 6. Advanced Nutrient Management: reported (blue) v. expected (magenta) results with 95% confidence intervals

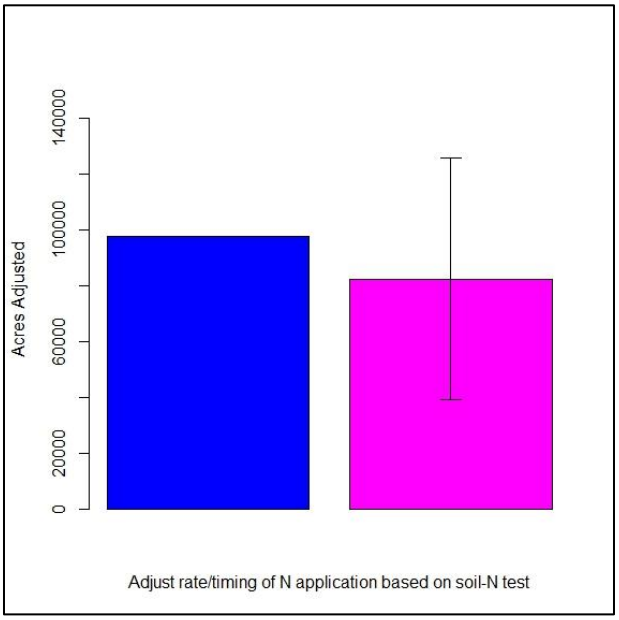


Figure 7. Animal Waste Storages: reported (blue) v. expected (magenta) results with 95% confidence intervals

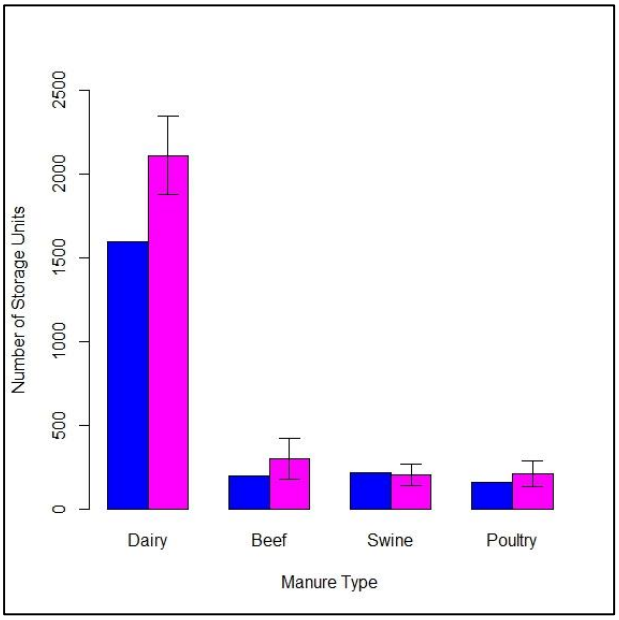


Figure 8. Barnyard Runoff Controls: reported (blue) v. expected (magenta) results with 95% confidence intervals

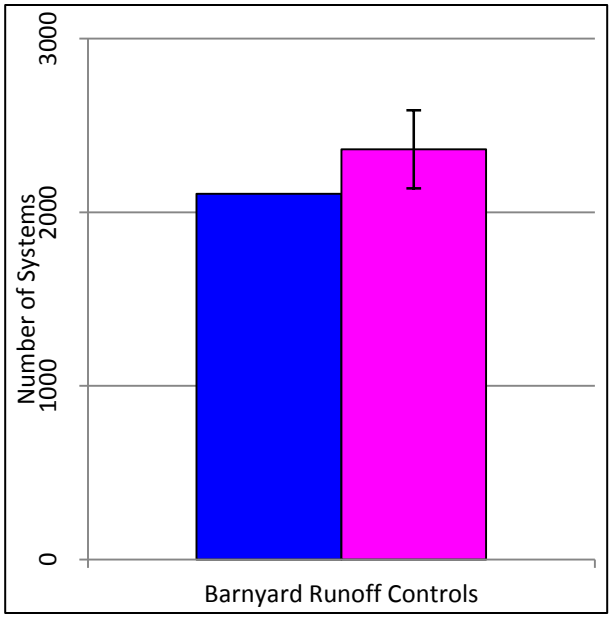


Figure 9. Agricultural E&S Plans: reported (blue) v. expected (magenta) results with 95% confidence intervals

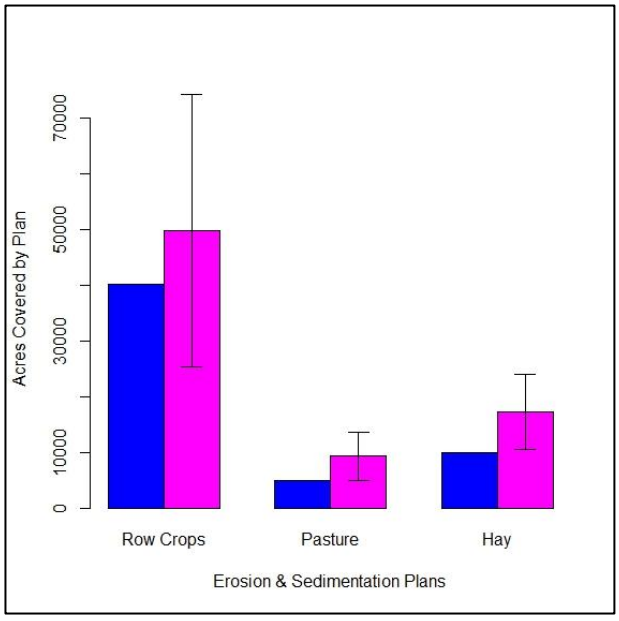


Figure 10. Conservation Plans: reported (blue) v. expected (magenta) results with 95% confidence intervals

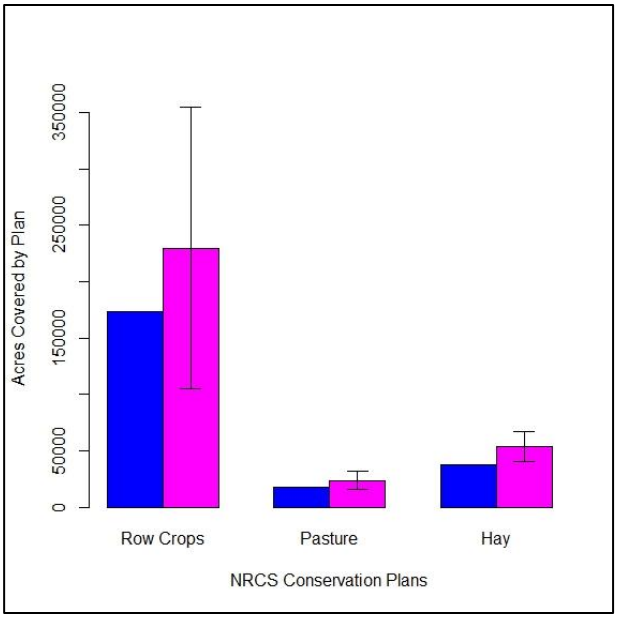


Figure 11. Stream Bank Fencing: reported (blue) v. expected (magenta) results with 95% confidence intervals

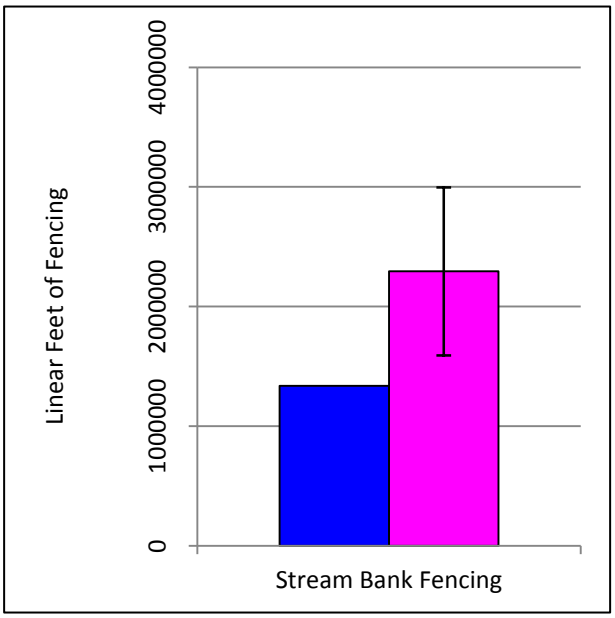


Figure 12. Watercourse Access Controls: reported (blue) v. expected (magenta) results with 95% confidence intervals

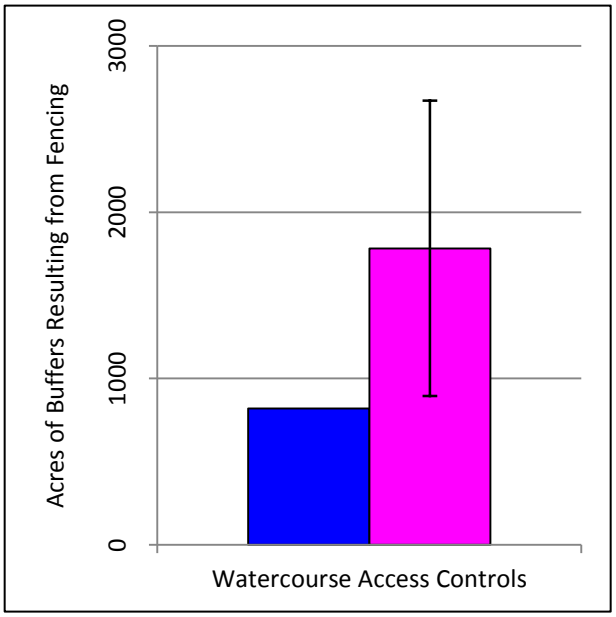
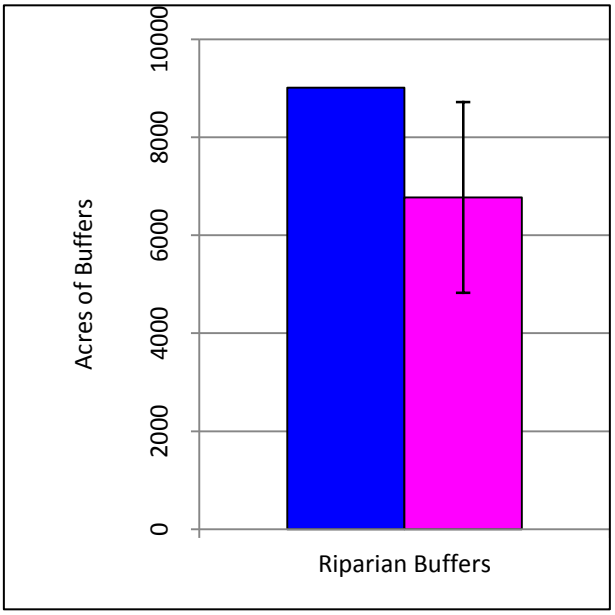


Figure 13. Riparian Buffers: reported (blue) v. expected (magenta) results with 95% confidence intervals



Statistical analysis of the aggregate dataset using the subsample developed through the verification farm visits allows us to conclude the farm survey results are accurate. However, we note that in their assessment report of our study, Tetra Tech recommends additional analysis to determine county-to-county variability of accuracy. In response to this recommendation, we explored potential regional differences in reporting to see if this may possibly make county based division of the aggregate data less reliable. County based reporting of data is the Commonwealth's preferred method of reporting to the Chesapeake Bay Program.

Preliminary county based analysis revealed that, for the vast majority of practices in the vast majority of counties, the sample size was too small to make any statistically significant conclusions. As an alternative, we grouped the data into multiple counties based on river basin designation as shown in Table 3.

Table 3. River basin regions used for geographic statistical analysis

River Basin	Counties	# Farms Visited
Potomac	Somerset, Bedford, Fulton, Franklin, Adams	96
Juniata	Huntingdon, Mifflin, Juniata, Blair, Perry	70
Upper Susquehanna	Potter, Tioga, Bradford, Susquehanna, Wayne, Wyoming, Lackawanna, Luzerne, Columbia, Montour, Union, Sullivan, Lycoming, Clinton, Centre, Clearfield, Cameron, Elk, McKean, Cambria, Indiana, Jefferson	226
Lower Susquehanna	Snyder, Northumberland, Dauphin, Schuylkill, Berks, Lebanon, Lancaster, Chester, Cumberland, York	318

Because sample size in each river basin varies for each practice depending on whether the farm visited reported the practice, small sample sizes continued to contribute to challenges in analyzing the data for statistical reliability. For some regions, statistically significant results were obtained for pasture acres in nutrient management, dairy and beef manure storages, barnyard runoff controls, hay acres in agricultural E&S and conservation plans, and stream bank fencing. For all of these practices, systematic under reporting in river basins was confirmed, which is consistent with the aggregate data results. Also statistically significant and consistent with the aggregate data results is a systematic over reporting of riparian buffers in two of the four river basins. Given the consistency of data where we were able to determine statistical significance, we do not find evidence of any regional variability from the aggregate data results.

Figures 14 through 21 display the per farm mean differences between the reported and verified data for the aggregate data compared to river basin specific data in all cases where data was statistically significant. The error bars represent the ranges of the 95% confidence intervals. The graphs reveal no significant geographic variability from the aggregate data.

Figure 14. Mean differences for aggregate data for nutrient management plans compared to Lower and Upper Susquehanna county data

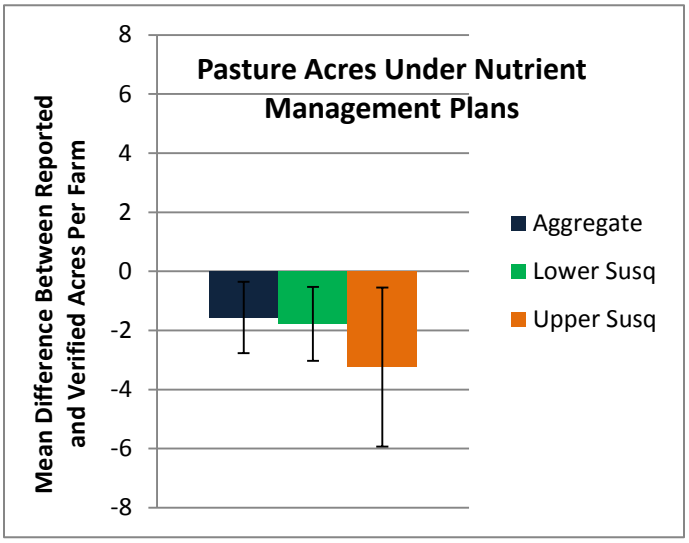


Figure 15. Mean differences for aggregate data for dairy manure storages compared to Lower Susquehanna county data

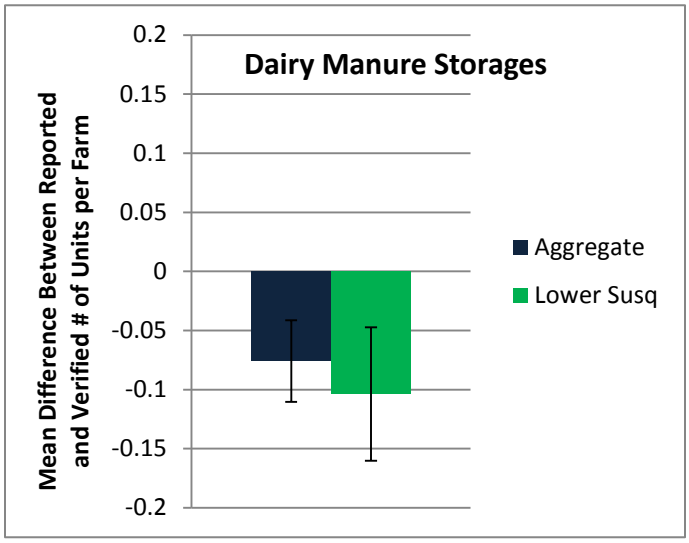


Figure 16. Mean differences for aggregate data for beef manure storages compared to Lower Susquehanna county data

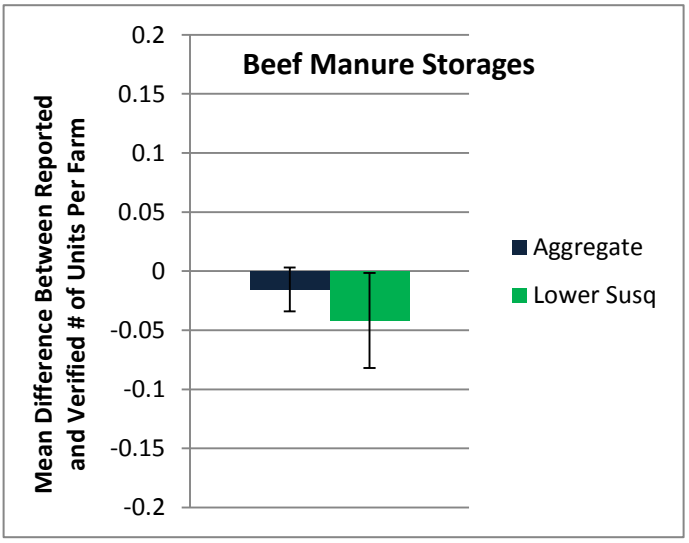


Figure 17. Mean differences for aggregate data for barnyard runoff control systems compared to Upper Susquehanna county data

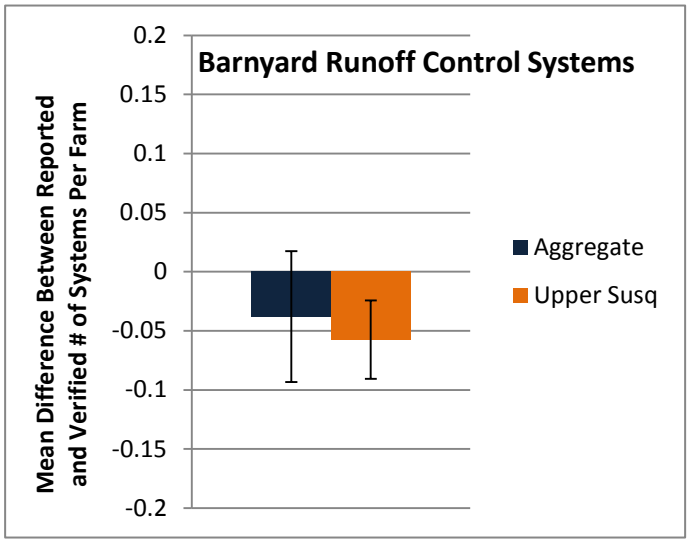


Figure 18. Mean differences for aggregate data for Ag E&S Plans compared to Upper Susquehanna county data

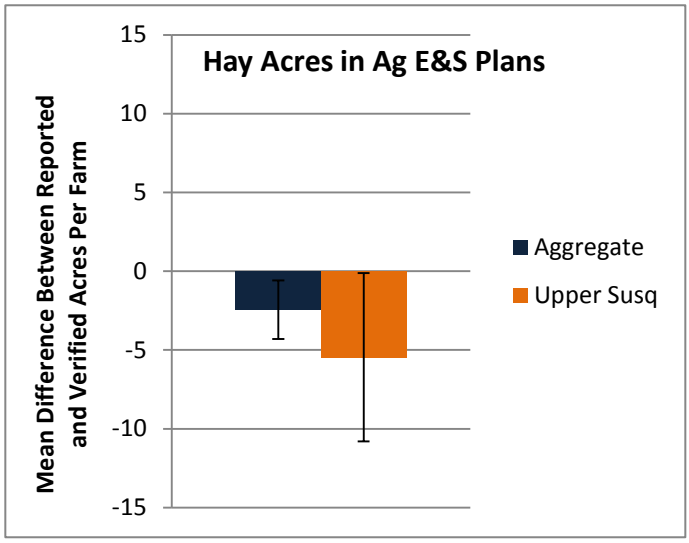


Figure 19. Mean differences for aggregate data for Conservation Plans compared to Upper Susquehanna county data

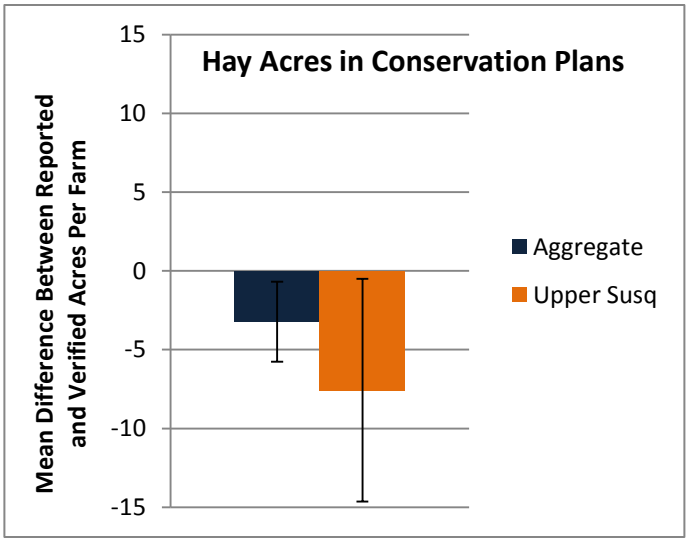


Figure 20. Mean differences for aggregate data for stream bank fencing compared to Upper Susquehanna county data

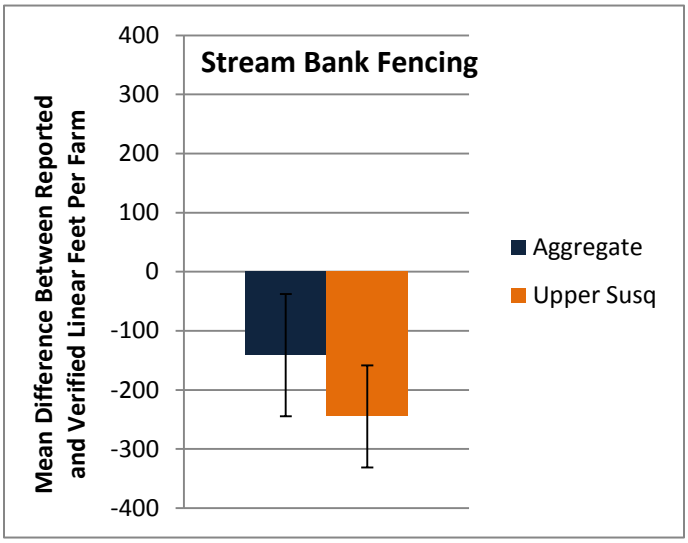
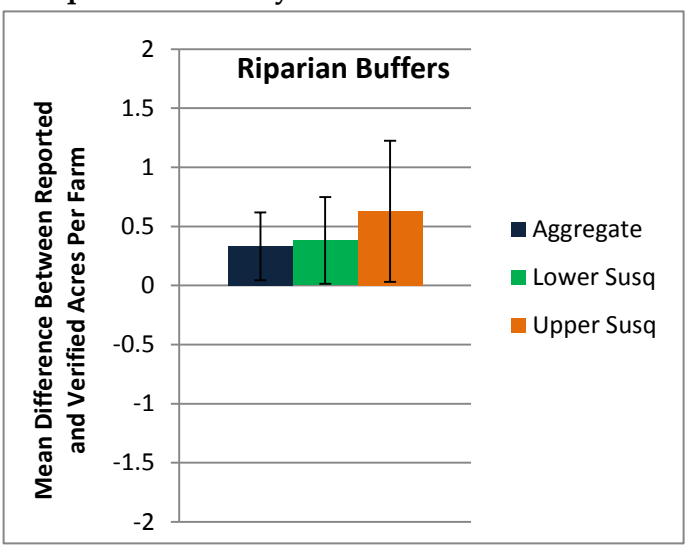


Figure 21. Mean differences for aggregate data for riparian buffers compared to Lower and Upper Susquehanna county data



Because river basin analysis reveals no evidence of regional variability, our analysis of the aggregate data supports reporting of the cumulative data on the relevant conservation practices reported in the 6,782 survey returns, and we are comfortable with this data being reported to the Bay Program on a county basis.

To address and account for the most accurate reporting for credit in the Bay model, we apply an appropriate factor to address under reporting and over reporting, as also recommended in the Tetra Tech report. This is most appropriately accomplished by using the mean per farm deviation between reported and verified numbers as our adjustment factor, with the adjustment calculated as described above and represented by the magenta bar in Figures 5-13. With this adjustment, cumulative practices are summarized in Table 4.

Table 4. Cumulative results by conservation practice from reported farm surveys as adjusted to account for systematic under and over reporting

Practice	Amount Implemented			
Nutrient/manure management plans	350,103 ac row crops	40,769 ac pasture	115,514 ac hay	
Enhanced nutrient management	82,303 ac			
Animal Waste Management Storages	2,113 dairy units	299 beef units	318 swine units	207 poultry units
Barnyard Runoff Controls	2,364 systems			
Agricultural E&S plans	60,380 ac row crops	13,068 ac pasture	26,521 ac hay	
Conservation plans	229,636 ac row crops	23,818 ac pasture	59,450 ac hay	
Stream bank fencing	2,293,651 linear feet			
Watercourse access controls	Grass 10-35 ft width: 684 ac	Grass >35 ft width: 994 ac		
Riparian buffers	Grass 10-35 ft width: 342 ac	Grass >35 ft width: 620 ac	Forest 10-35 ft width: 850 ac	Forest >35 ft width: 4,958 ac

Conclusion

This survey has shown to be a statistically reliable method for gathering data on implemented conservation practices through farmer self-reporting. It has proven extremely valuable in reporting voluntary, non-cost shared practices that, to date, have not been adequately captured and reported for credit in the Chesapeake Bay model. The cumulative numbers reveal a large amount of conservation being implemented by farmers outside of government cost share programs, so capturing this data is not insignificant.

We have shown that our statistical analysis allows us to confidently adjust reported numbers to account for systematic under reporting and over reporting. However, in order to ensure the numbers provided to the Commonwealth for reporting to the Chesapeake Bay model eliminate all possible potential for over reporting, we recommend applying our statistical analysis to adjust only for systematic over reporting of riparian buffers, and not adjusting numbers for the other practices where systematic under reporting was evident. Following this adjustment, Table 5 summarizes the final cumulative practices we recommend for reporting to the Chesapeake Bay Program:

Table 5. Cumulative results by conservation practice to be reported to Chesapeake Bay Program (adjusted only for systematic over reporting of riparian buffers)

Practice	Amount Implemented			
Nutrient/manure management plans	335,250 ac row crops	37,243 ac pasture	103,307 ac hay	
Enhanced nutrient management	97,562 ac			
Animal Waste Management Storages	1,598 dairy units	194 beef units	213 swine units	159 poultry units
Barnyard Runoff Controls	2,106 systems			
Agricultural E&S plans	40,170 ac row crops	4,930 ac pasture	9,973 ac hay	
Conservation plans	173,481 ac row crops	17,239 ac pasture	37,544 ac hay	
Stream bank fencing	1,336,100 linear feet			
Watercourse Access Controls	Grass 10-35 ft width: 324 ac	Grass >35 ft width: 471 ac		
Riparian buffers	Grass 10-35 ft width: 342 ac	Grass >35 ft width: 620 ac	Forest 10-35 ft width: 850 ac	Forest >35 ft width: 4,958 ac

With a total sample size of 6,782 surveys providing valuable information on farming operations and conservation practices, this is an extremely rich dataset. While this report addresses and we have concentrated on only those non-cost shared practices not previously reported by the Commonwealth for credit in the Chesapeake Bay model, a great deal of further analysis of the data is warranted. Further analysis will allow us to explore many questions, such as questions related to trends in conservation practice adoption and cost share program participation, including variability in trends between regions, farm types and sizes, and types of practices. We hope this further analysis will be of great value to the conservation and agricultural community in setting future priorities and objectives and allocating limited resources to achieve the greatest conservation results.

Appendix A: Farm Survey

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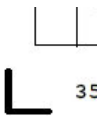
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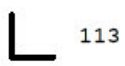
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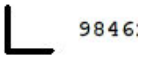

Appendix B: Farm Visit Report

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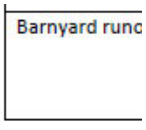
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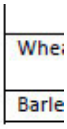
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Appendix C: BMP Survey Verification Summary

Explanation of Sources of Data Used to Develop "Reported" and "Verified" Values

Nutr Mgmt Plan Acres

Acres under nutrient management plans were analyzed separately for plans covering three land types: row crops, pasture, and hay.

The columns labeled "reported" include farm-level answers to question 5e. (acres covered by a nutrient management plan) of the original mail/web survey, for each land type.

The columns labeled "verified" includes each respondents' answer to question 1f. (acres covered by a nutrient management plan) of the farm visit report, for each land type.

The columns labeled "difference" subtract "verified" from "reported".

Nutr Mgmt Plan Acres by Plan Type

In this sheet, we break down the responses further according to the type of nutrient management plan employed and whether the plan was developed using any public funds (except for Manure Management Plans). Acres under nutrient management plans were analyzed separately for Act 38 Nutrient Management Plans, NRCS 590 Nutrient Management Plans, and Manure Management Plans. Acres were further separated according to whether the plans applied to row crops, pasture, and hay.

Act 38 Nutrient Management Plans

Reported: question 5e. of the original mail/web survey conditional on selecting "Act 38 Nutrient Management Plan" in question 5a. and on selecting "No" (public funds) in question 5c. of the same survey.

Verified: question 1f. of the farm visit report conditional on selecting "Act 38 Nutrient Management Plan" in question 1a. and selecting "No" (public funds) in question 1d. of the same survey.

NRCS 590 Nutrient Management Plans

Reported: question 5e. of the original mail/web survey conditional on selecting "NRCS 590 Nutrient Management Plan" in question 5a. and on selecting "No" (public funds) in question 5c. of the same survey.

Verified: question 1f. of the farm visit report conditional on selecting "NRCS 590 Nutrient Management Plan" in question 1a. and selecting "No" (public funds) in question 1d. of the same survey.

Manure Management Plans

Reported: question 5e. of the original mail/web survey conditional on selecting "Manure Management Plan" in question 5a of the same survey.

Verified: question 1f. of the farm visit report conditional on selecting "Manure Management Plan" in question 1a of the same survey.

Enhanced Nutrient Management

Reported: question 6b. of the original mail/web survey (acres on which nitrogen application is adjusted based on a soil nitrogen test)

Verified: question 2b. of the farm visit report (acres on which nitrogen application is adjusted based on a soil nitrogen test)

Manure Transport

Due to the scarcity of farms that transported any particular manure type, original responses were simply listed alongside their corresponding farm visit report without any statistical analysis.

In the excel sheet, plain text represents responses from the original mail/web survey, while bold text represents the reports from the farm visits.

Manure Storage Unit

We analyzed manure storage units separately for dairy manure, beef manure, swine manure, and poultry manure.

Reported: total number of manure storage units (of a particular type) reported in question 8a. of the original mail/web survey

Verified: total number of manure storage units (of the corresponding type) reported in question 8a. of the farm visit report

Barnyard Runoff Control

We defined a "barnyard runoff control system" as a barnyard that had at least one of the following practices: roof runoff structures, curbs, collection systems and/or pumps, or barnyard runoff filter strips.

Reported: equal to 1 if the farm reported having a "barnyard runoff control system" in question 9b. of the original mail/web survey

Verified: equal to 1 if question 4a. of the farm visit report indicated that the farm had a "barnyard runoff control system"

In addition to analyzing the reporting accuracy of "barnyard runoff control systems," we also analyzed the reporting accuracy of each of the five individual runoff control practices included in the survey: roof runoff

structures, concrete barnyards, curbs, collection systems and/or pumps, barnyard runoff filter strips.

Reported: equal to 1 if the farm reported having the practice in question 9b. of the original mail/web survey

Verified: equal to 1 if question 4a. of the farm visit report indicated that the farm had the practice

Erosion and Sedimentation Plans

Acres covered by agricultural erosion and sedimentation control plans were analyzed separately for four land types: row crops, pasture, hay, and barnyard. We included acres here whether or not the farmer received government funds.

Reported: question 10a. (acres under plan, by land type) conditional on selecting "E&S Plan"

Verified: question 6a. (acres under plan, by land type) conditional on selecting "E&S Plan"

NRCS Conservation Plans (privately funded)

Acres covered by NRCS conservation plans were analyzed separately for four land types: row crops, pasture, hay, and barnyard. Here we included acres only if the farm did not indicate that they received federal funds.

Reported: question 10a. (acres under plan, by land type) conditional on selecting "NRCS Conservation Plan" and on selecting "No" for whether federal funds were used to develop the plan

Verified: question 6a. (acres under plan, by land type) conditional on selecting "NRCS Conservation Plan" and on selecting "No" for whether federal funds were used to develop the plan

Stream Bank Fencing

Fencing Length

Reported: Linear feet of fencing reported in question 13a. of the original mail/web survey

Verified: Linear feet of fencing reported in question 9a. of the farm visit report

Distance from Stream to Fence

Reported: average distance (feet) from the stream to the fence reported in question 13b. of the original mail/web survey

Verified: average distance (feet) from the top of the stream bank to the fence as reported in question 9b. of the farm visit report

Privately Funded Fencing Length

Reported: Linear feet of fencing reported in question 13a. of the original mail/web survey minus that reported in question 13d. (the amount constructed using government funds)

Verified: Linear feet of fencing reported in question 9a. of the farm visit report minus that reported in question 9c. (linear feet constructed using county, state, or federal funds)

Acres of Buffer (fencing length x distance to stream)

Reported: the linear feet of fencing reported in question 13a. times the average distance between the stream and the fence reported in question 13b. divided by 43560 (square feet per acre)

Verified: the linear feet of fencing reported in question 9a. times the average distance between the stream and the fence reported in question 9b. divided by 43560

Acres of Privately Funded Buffer (fencing length x distance to stream)

Reported: the linear feet of privately funded fencing computed above times the distance between the stream and the fence reported in question 13b. divided by 43560 (square feet per acre)

Verified: the linear feet of privately funded fencing computed above times the average distance between the stream and the fence reported in question 9b. divided by 43560

Riparian Buffers

Buffer Acres

Reported: buffer acres indicated in question 14a of the original mail/web survey

Verified: buffer acres indicated in question 10a of the farm visit report

Privately Funded Buffer Acres

Reported: buffer acres indicated in question 14a minus acres of publicly funded buffers indicated in question 14e

Verified: buffer acres indicated in question 10a minus acres of publicly funded buffers indicated in question 10f.

Buffer Width

Reported: buffer width reported in question 14b of the original mail/web survey

Verified: buffer width reported in question 10b of the farm visit report

Categories of Reports

For some of the practices verified, I classify reports by four types--

Category 0: zero acres (or other units) reported in mail/web survey, zero acres (or other units) reported in farm visit

Category 1: positive acres reported in mail/web survey, but zero acres reported in farm visit

Category 2: zero acres reported in mail/web survey, but positive acres reported in farm visit

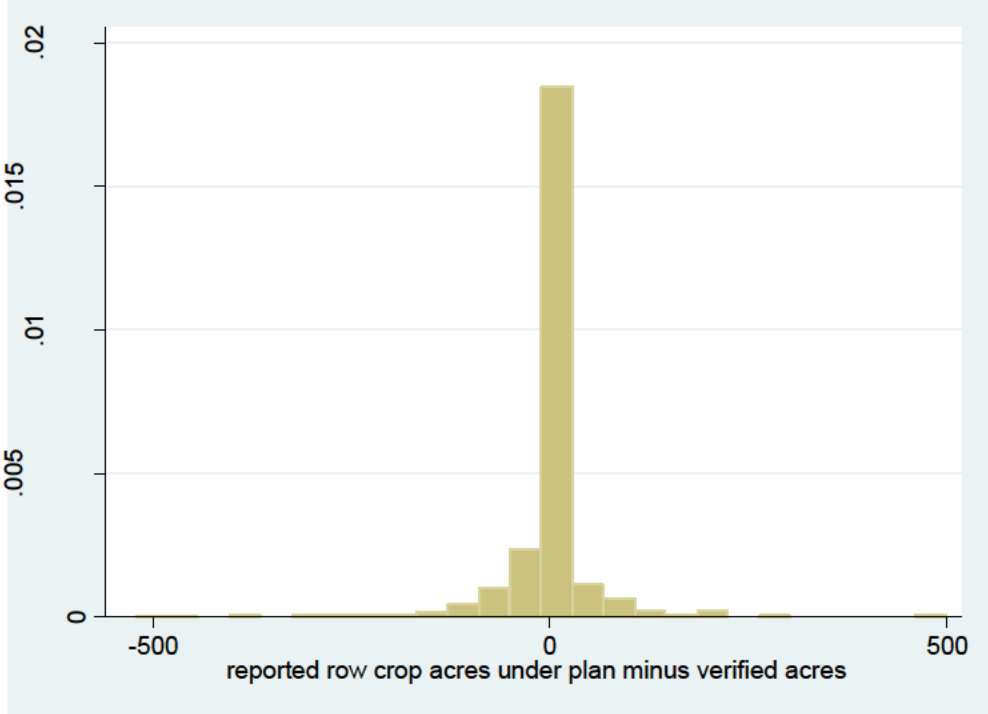
Category 3: positive acres reported in both mail/web survey and farm visit

Practice by Practice Statistical Analysis and Histograms

Nutr Mgmt Plan Acres

ROW CROP ACRES (reported with and without a large outlier of +11000)

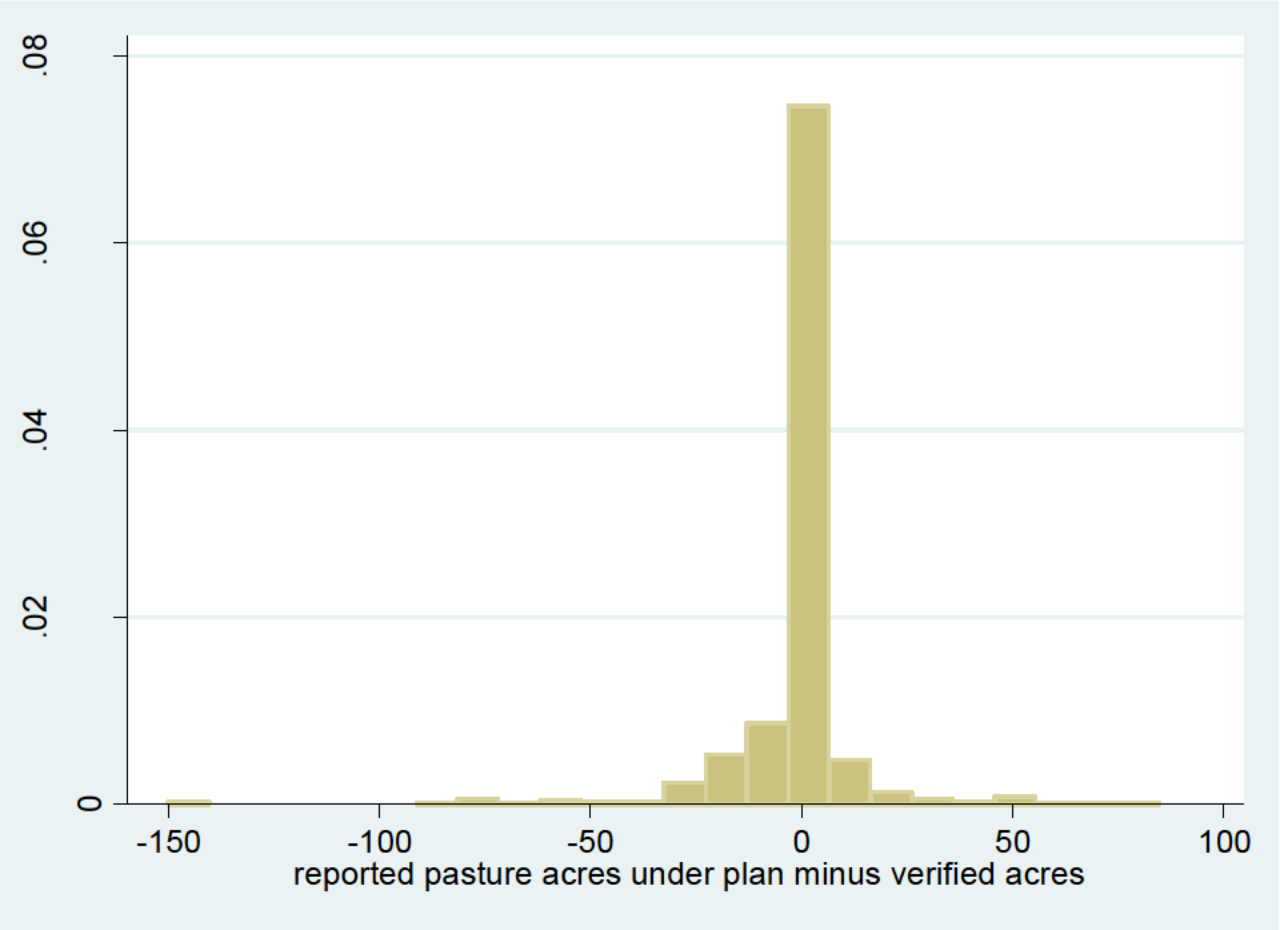
	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**372**	**52**	**0**	**---**	
Category 1	**34**	**5**	**79.05**	**10.26**	
w/ +11000	35	5	391.08	312.19	
Category 2	**70**	**10**	**-71.45**	**9.85**	
Category 3	**234**	**33**	**3.22**	**6.24**	**(-9.05, 15.51)**
Total	**710**	**100**	**-2.19**	**2.55**	**(-7.20, 2.81)**
w/ +11000	711	100	13.28	15.68	(-17.51, 44.07)



(graph excludes +11000)

PASTURE ACRES (reported with and without outliers of -400 and +1137.6)

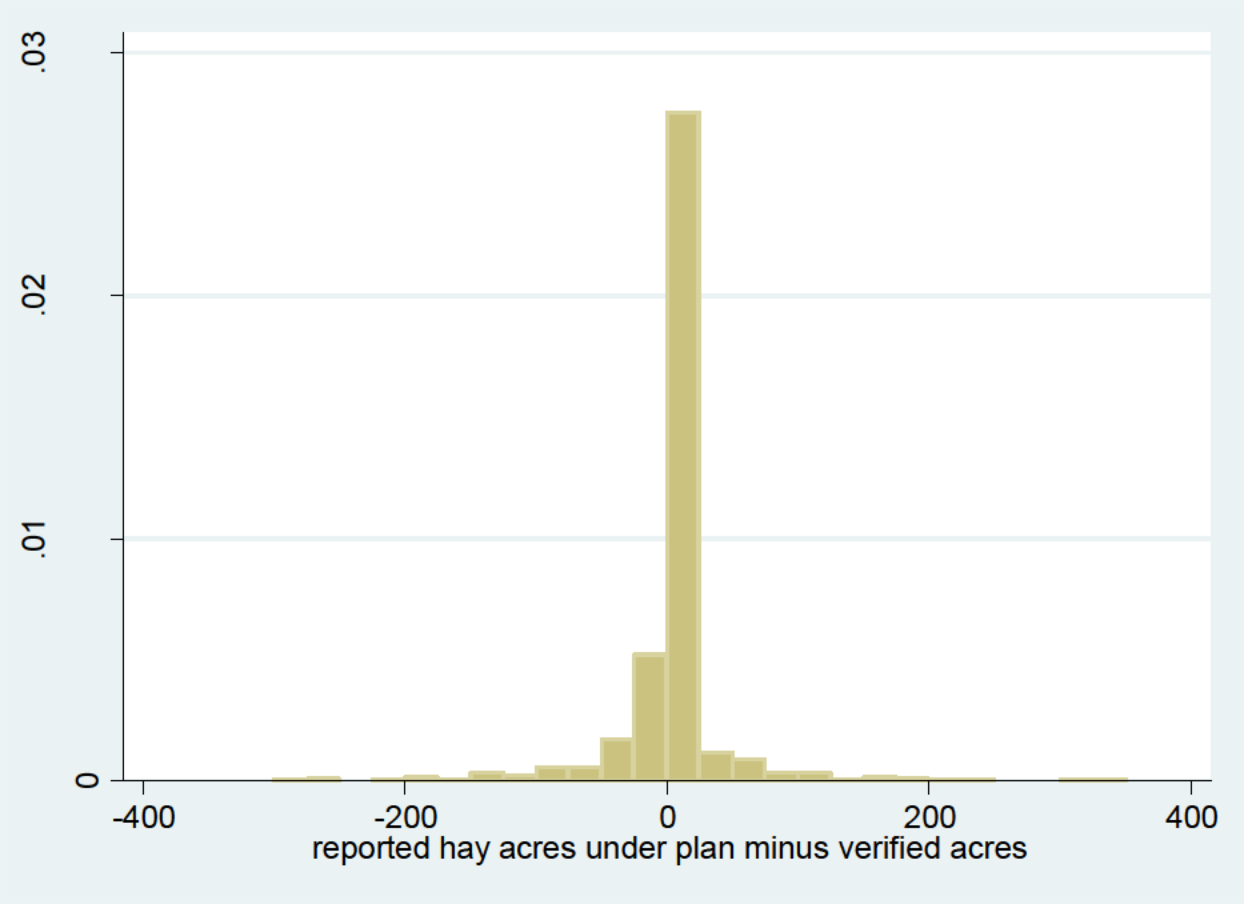
	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**411**	**58**	**0**	**---**	
Category 1	**37**	**5**	**20.81**	**3.15**	
Category 2	**100**	**14**	**-21.68**	**2.70**	
w/ -400	101	14	-25.42	4.60	
Category 3	**161**	**23**	**1.80**	**1.15**	**(-0.46, 4.07)**
w/ +1137.6	162	23	8.81	7.10	(-5.21, 22.84)
Total	**709**	**100**	**-1.56**	**0.62**	**(-2.77, -0.35)**
w/ outliers	711	100	-0.52	1.81	(-4.07, 3.03)



(graph excludes outliers)

HAY ACRES

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**393**	**55**	**0**	**---**	
Category 1	**55**	**8**	**60.45**	**9.44**	
Category 2	**87**	**12**	**-53.94**	**6.77**	
Category 3	**176**	**25**	**0.50**	**3.64**	**(-6.68, 7.68)**
Total	**711**	**100**	**-1.80**	**1.70**	**(-5.15, 1.55)**



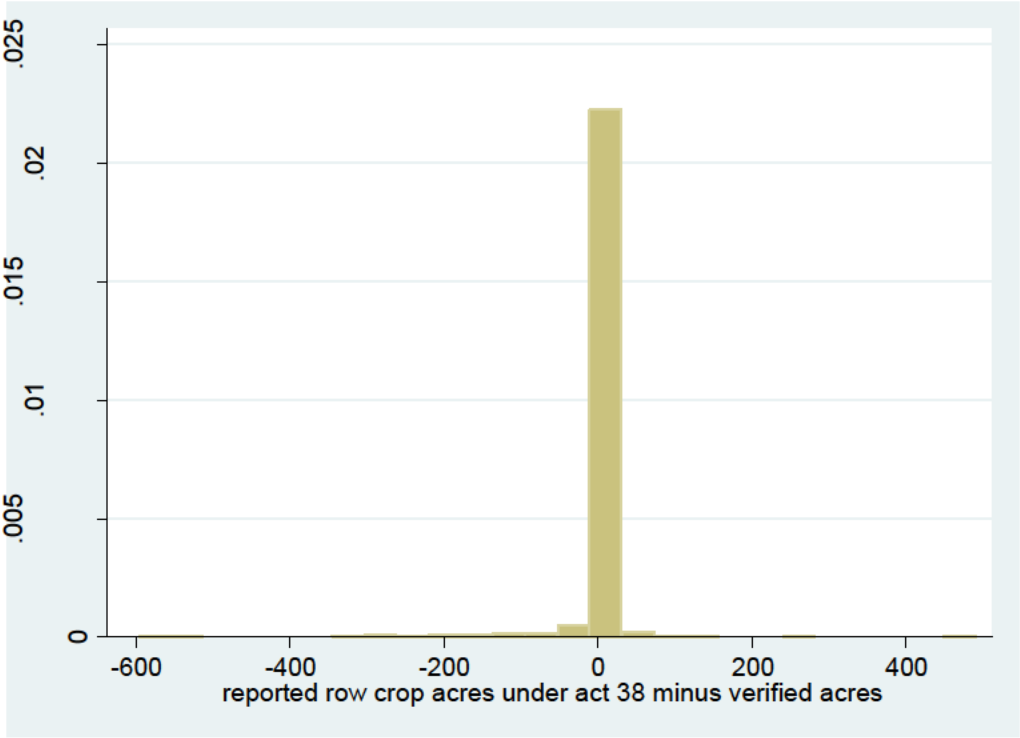
PRIVATELY FUNDED ACT 38 ROW CROP ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
prowprv_act38DIF	7.82	15.90	(-23.40, 39.04)

Drop +11000	Mean	Std. Err.	95% Conf. Int.
prowprv_act38DIF	-7.66	3.64	(-14.80, -0.52)

Drop +11000, -2170	Mean	Std. Err.	95% Conf. Int.
prowprv_act38DIF	-4.61	1.99	(-8.51, -0.71)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**649**		**0**		
Category 1	**10**		**95.80**	**45.32**	
w/+11000	11		1087.09	992.14	
Category 2	**36**		**-135.63**	**22.59**	
w/-2170	37		-189.17	57.87	
Category 3	**13**		**60.82**	**44.49**	**(-36.11, 157.75)**
Total	**709**		**-4.61**	**1.99**	**(-8.51, -0.71)**
w/outliers	711		7.82	15.90	(-23.40, 39.04)

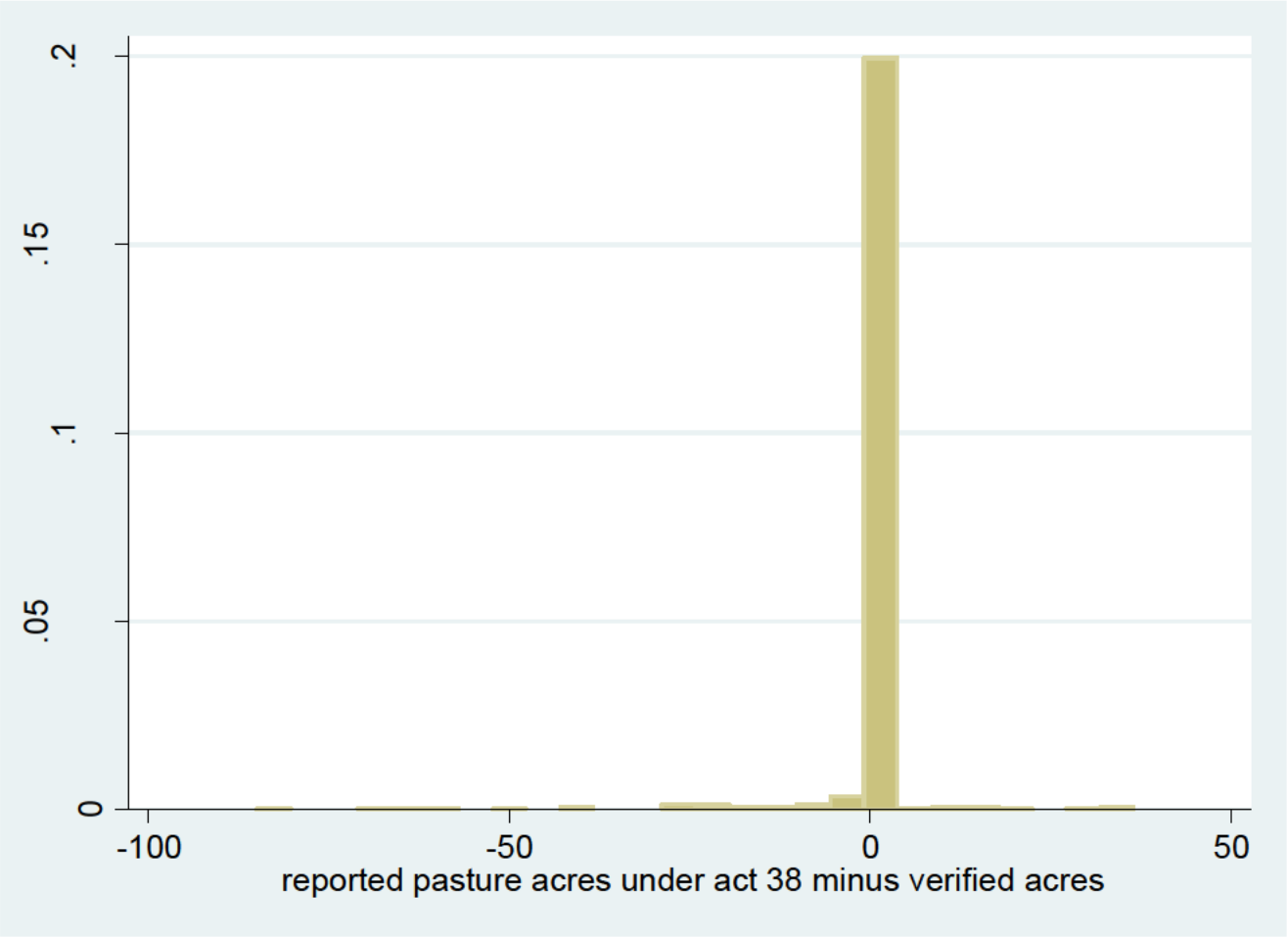


(graph excludes outliers)

PRIVATELY FUNDED ACT 38 PASTURE ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
ppasprv_act38DIF	-0.85	0.27	(-1.39, -0.31)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**660**		**0**		
Category 1	**9**		**16.78**	**3.02**	
Category 2	**36**		**-22.13**	**3.57**	
Category 3	**6**		**6.77**	**6.02**	**(-8.72, 22.25)**
Total	**711**		**-0.85**	**0.27**	**(-1.39, -0.31)**

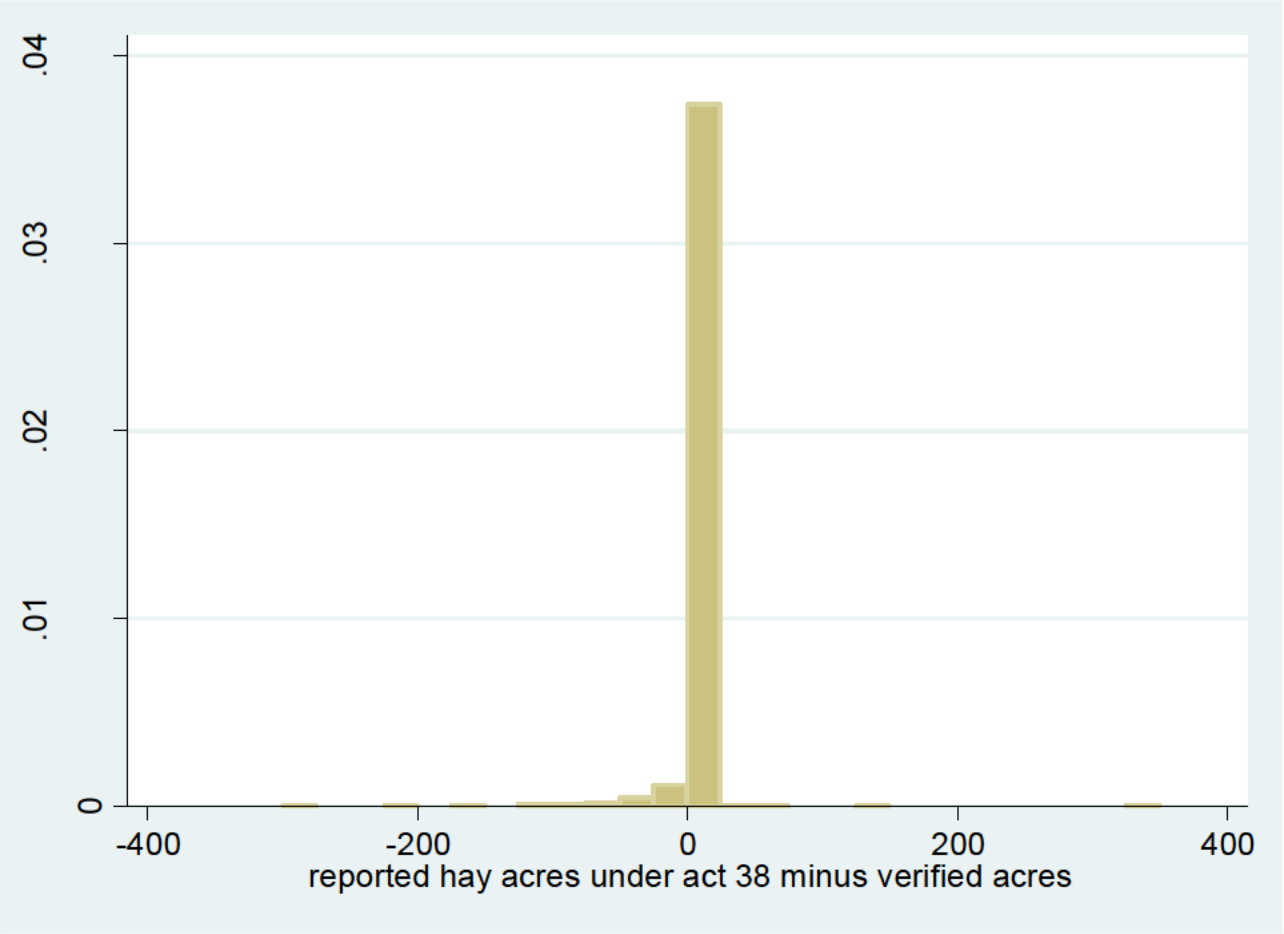


PRIVATELY FUNDED ACT 38 HAY ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
phayprv_act38DIF	-2.04	0.90	(-3.81, -0.28)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**659**		**0**		

Category 1	**9**	**72.44**	**37.14**	
Category 2	**39**	**-51.51**	**10.07**	
Category 3	**4**	**-24.25**	**26.74**	**(-109.36, 60.86)**
Total	**711**	**-2.04**	**0.90**	**(-3.81, -0.28)**

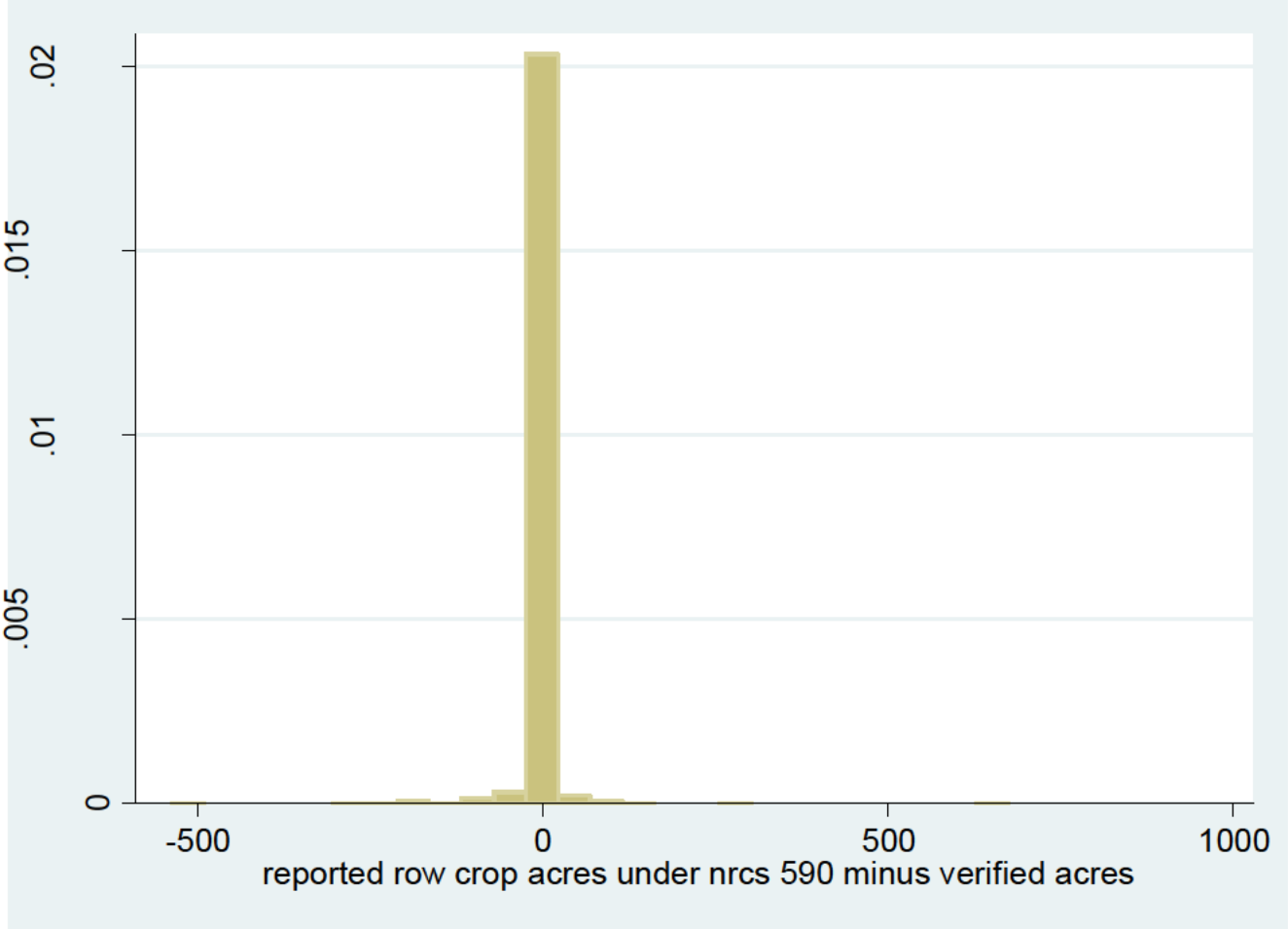


PRIVATELY FUNDED NRCS 590 ROW CROP ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.

prowprv_nrcs590DIF -1.24 1.55 (-4.29, 1.80)

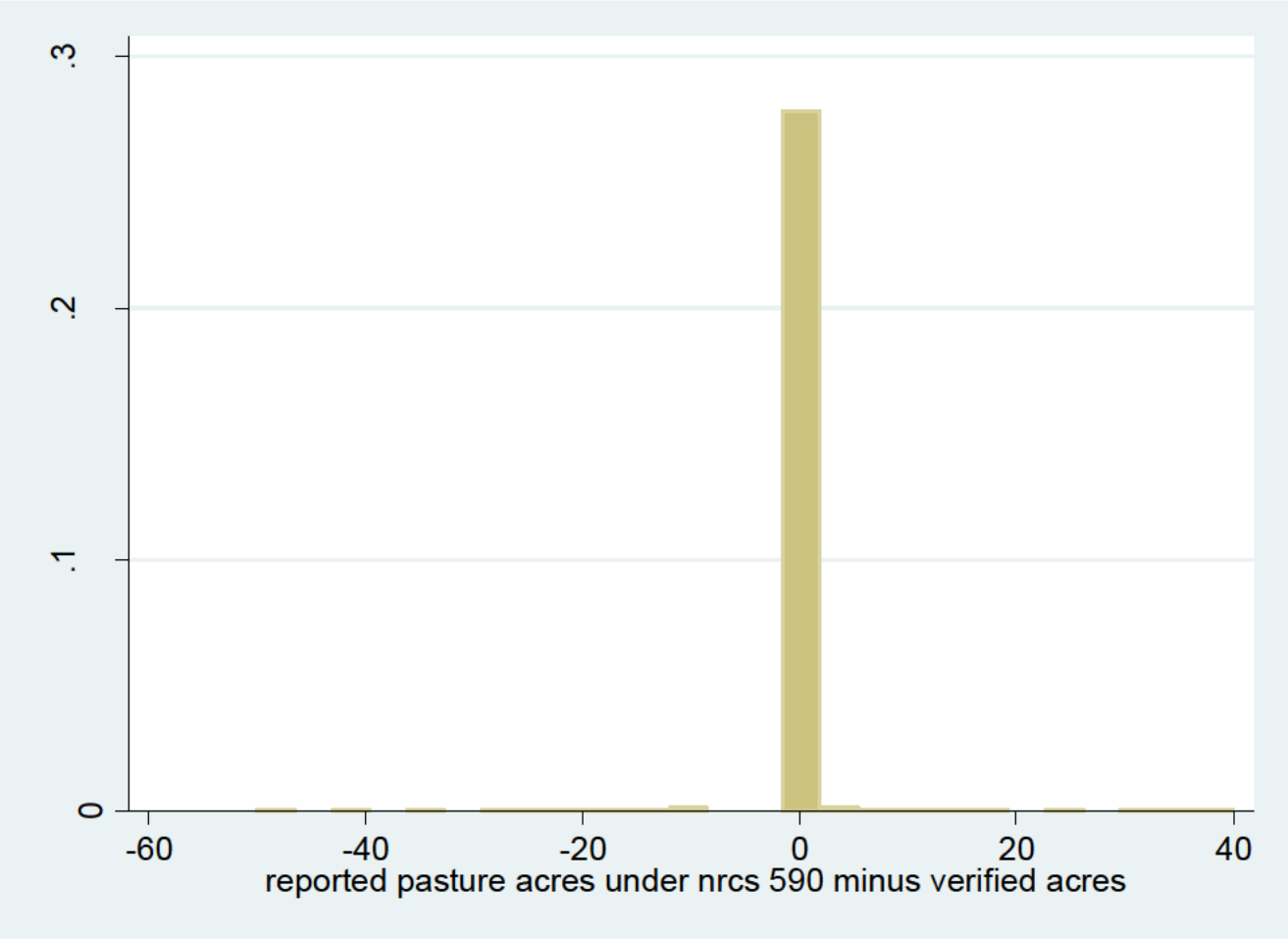
	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**670**		**0**		
Category 1	**13**		**125.66**	**50.51**	
Category 2	**22**		**-117.62**	**25.30**	
Category 3	**6**		**11.5**	**17.16**	**(-32.61, 55.61)**
Total	**711**		**-1.24**	**1.55**	**(-4.29, 1.80)**



PRIVATELY FUNDED NRCS 590 PASTURE ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
ppasprv_nrcs590DIF	0.08	0.33	(-0.57, 0.73)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**684**		**0**		
Category 1	**10**		**37.18**	**18.53**	
Category 2	**13**		**-24.03**	**3.72**	
Category 3	**4**		**0**	**8.50**	**(-27.04, 27.04)**
Total	**711**		**0.08**	**0.33**	**(-0.57, 0.73)**



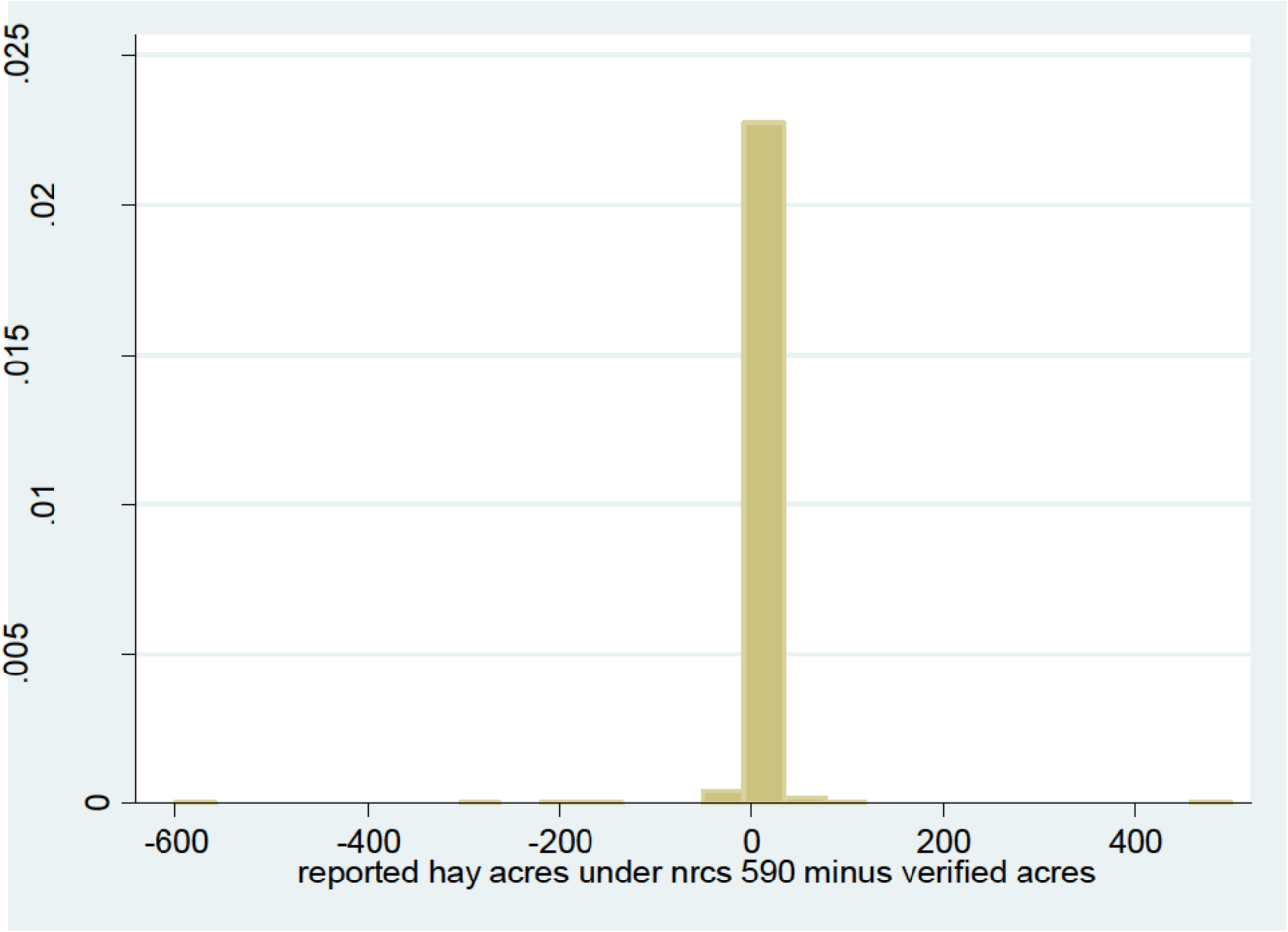
(graph excludes observation at +200)

PRIVATELY FUNDED NRCS 590 HAY ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
phayprv_nrcs590DIF	-0.86	1.30	(-3.41, 1.69)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**674**		**0**		

Category 1	**15**	**74.13**	**31.44**	
Category 2	**17**	**-102.47**	**37.58**	
Category 3	**5**	**3.4**	**4.19**	**(-8.23, 15.03)**
Total	**711**	**-0.86**	**1.30**	**(-3.41, -1.69)**



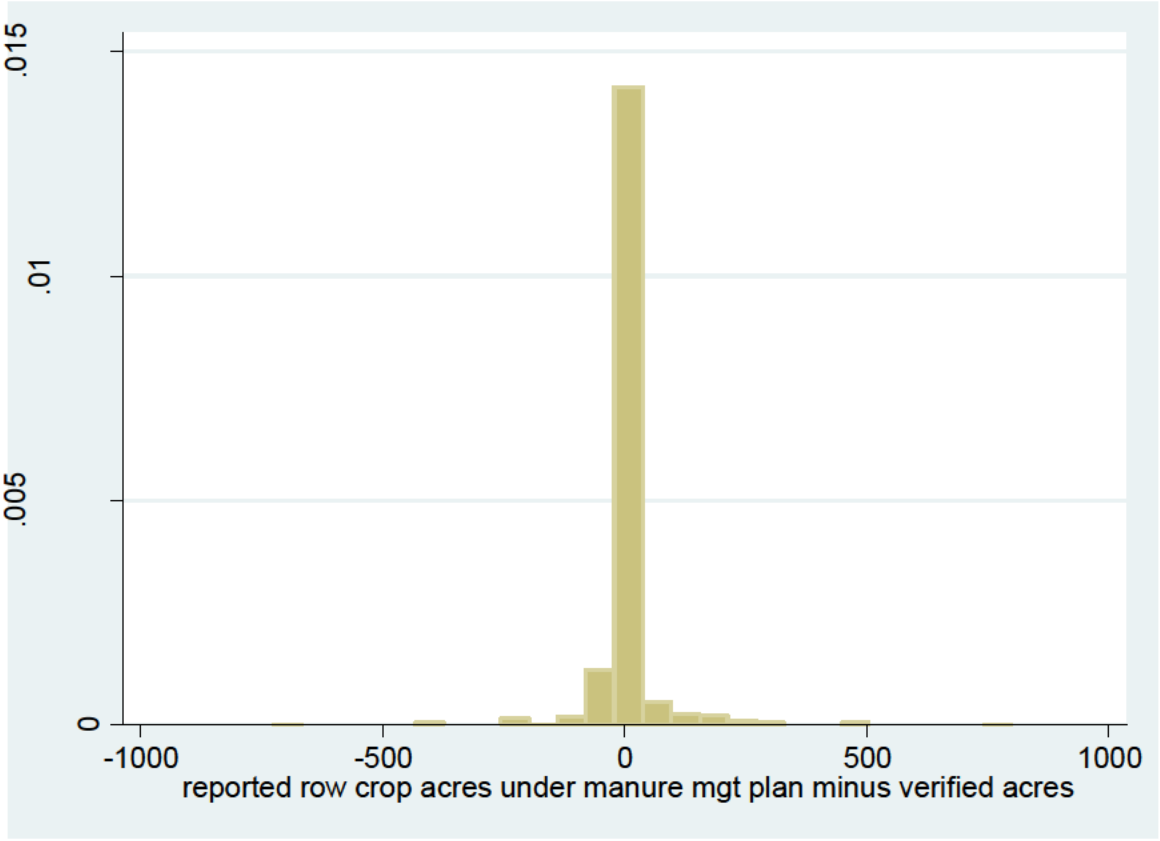
MANURE MANAGEMENT PLANS ON ROW CROP ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.

prow_mnrmgtDIF	7.06	4.97	(-2.69, 16.81)

Drop +3000	Mean	Std. Err.	95% Conf. Int.
prow_mnrmgtDIF	2.84	2.63	(-2.32, 8.00)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**506**		**0**		
Category 1	**56**		**119.23**	**17.80**	
w/+3000	57		169.77	53.48	
Category 2	**57**		**-81.84**	**15.19**	
Category 3	**91**		**0.07**	**8.50**	**(-16.82, 16.96)**
Total	**710**		**2.84**	**2.63**	**(-2.32, 8.00)**
w/+3000	711		7.06	4.97	(-2.69, 16.81)

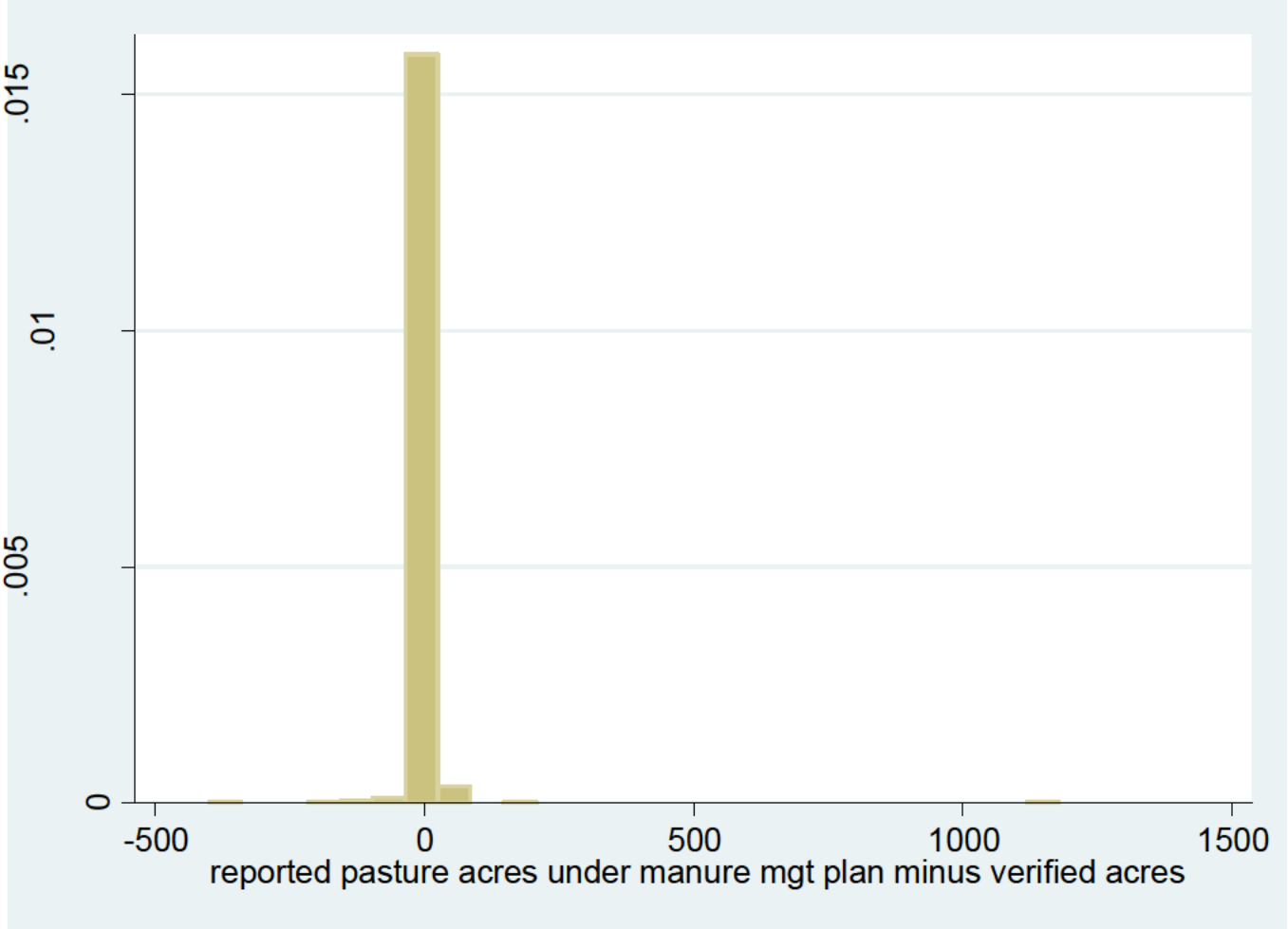


(graph excludes observation at +3000)

MANURE MANAGEMENT PLANS ON PASTURE ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
ppas_mnrmgtDIF	0.44	1.85	(-3.20, 4.08)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**530**		**0**		
Category 1	**45**		**50.33**	**25.98**	
Category 2	**69**		**-29.14**	**6.82**	
Category 3	**67**		**0.89**	**1.34**	**(-1.78, 3.56)**
Total	**711**		**0.44**	**1.85**	**(-3.20, 4.08)**

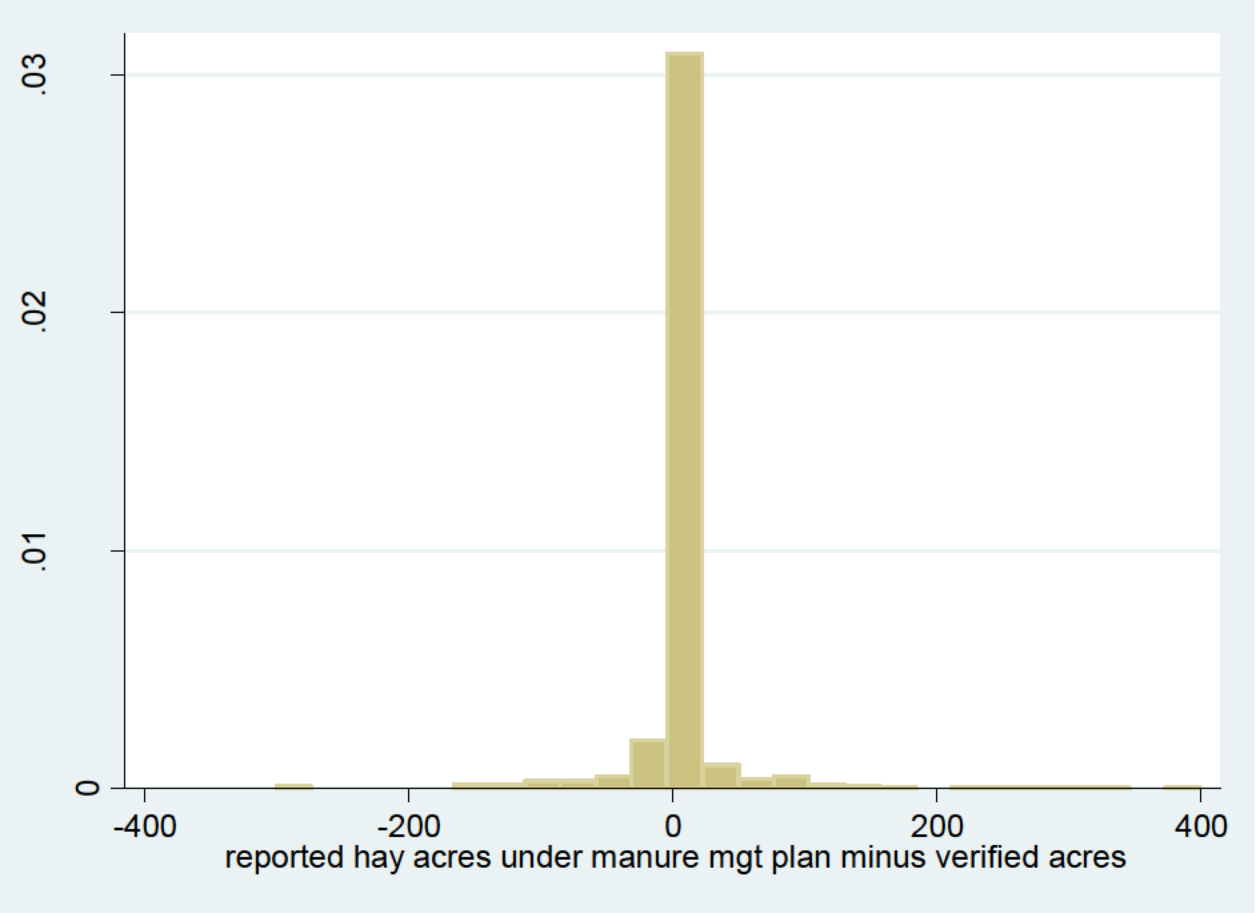


MANURE MANAGEMENT PLANS ON HAY ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
phay_mnrmgtDIF	2.25	1.54	(-0.78, 5.27)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**529**		**0**		

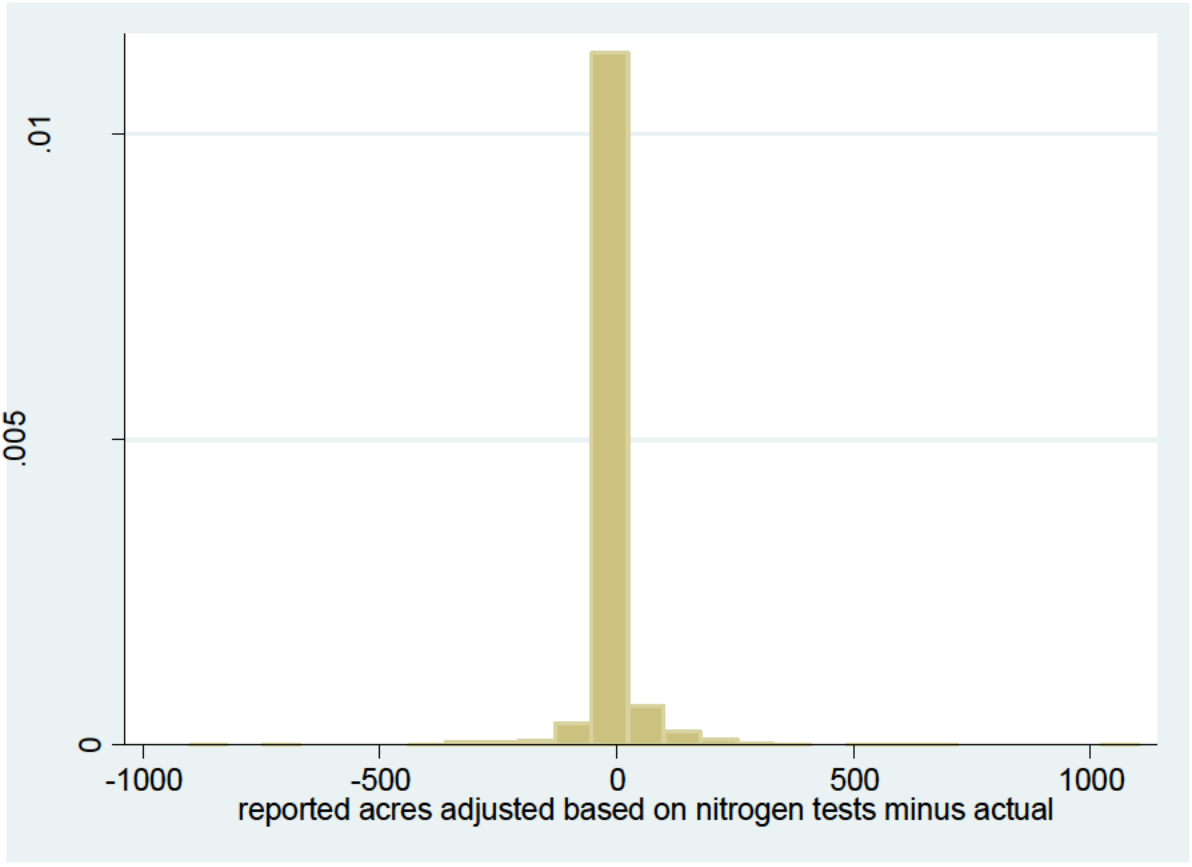
Category 1	56	76.96	11.59	
Category 2	51	-56.51	8.92	
Category 3	75	2.26	4.10	(-5.91, 10.42)
Total	711	2.25	1.54	(-0.78, 5.27)



Advanced Nutr Mgmt

Raw variable	Mean	Std. Err.	95% Conf. Int.
adjDIF	15.61	13.75	(-11.38, 42.60)
Drop +9500	Mean	Std. Err.	95% Conf. Int.
adjDIF	2.25	3.26	(-4.314, 8.65)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**564**	**79**	**0**	**---**	
Category 1	**63**	**9**	**117.58**	**21.68**	
w/ +9500	64	9	264.18	148.15	
Category 2	**54**	**8**	**-104.82**	**19.11**	
Category 3	**29**	**4**	**-5.06**	**35.06**	**(-76.88, 66.76)**
Total	**710**	**100**	**2.25**	**3.26**	**(-4.14, 8.65)**
w/ +9500	711	100	15.61	13.75	(-11.38, 42.60)



(graph excludes the +9500 observation)

Manure Transport (no statistical analysis)

Manure Storage

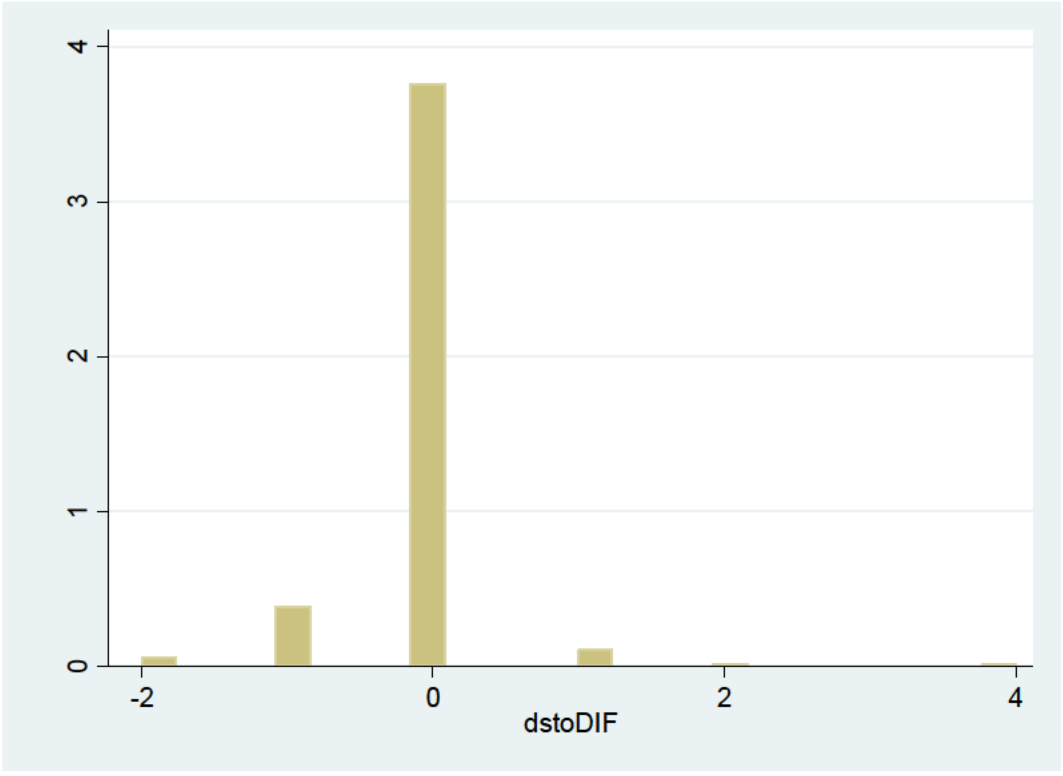
Difference between number of storage units reported in the mail/web survey and number of units reported in the farm visits

DAIRY (-54)

N = 711

Mean	Std. Err.	95% Conf. Interval
-.0759	.0176	(-.1105, -.0414)

It might help to think of the mean here as a proportion, so (on average) about 1 in 12 of the farms (8 percent) in the original survey that did not report a dairy manure storage unit actually had one.



Value	Freq.	Percent

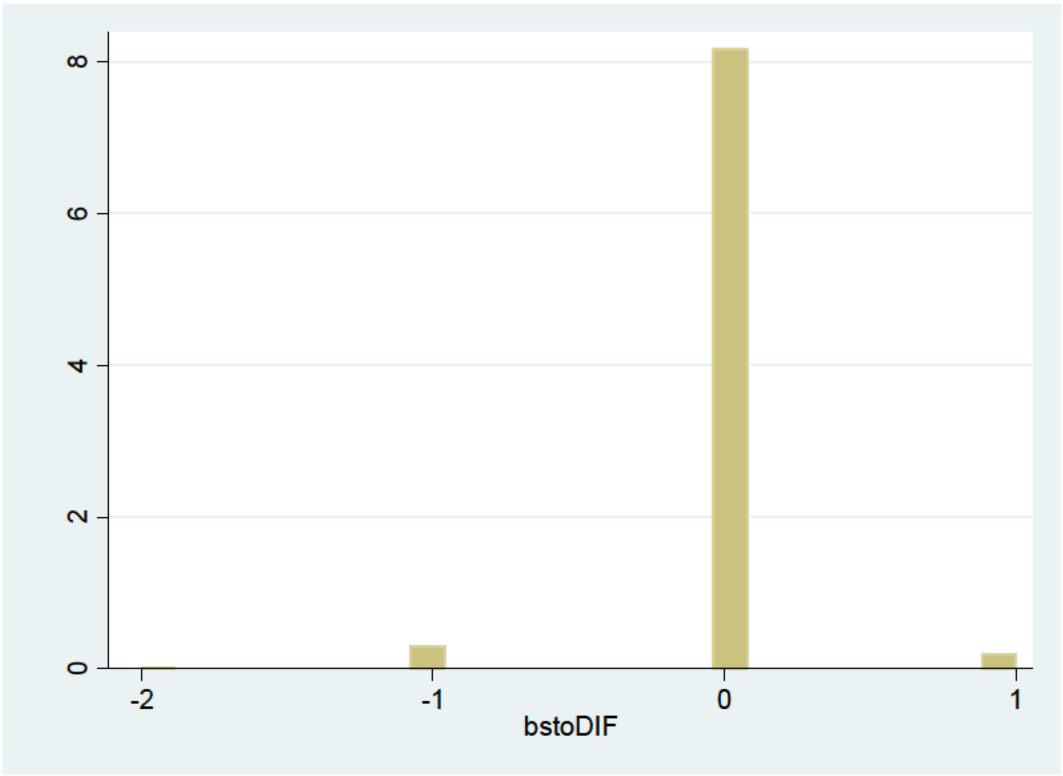
	-2	10	1.41
	-1	63	8.86
	0	617	86.78
	1	17	2.39
	2	2	0.28
	4	2	0.28
Total	-54	711	100.00

BEEF (-11)

N = 711

Mean	Std. Err.	95% Conf. Interval
-.0155	.0094	(-.0340, .0030)

On average about 1 in 60 farms that reported no beef manure storage units actually had one.



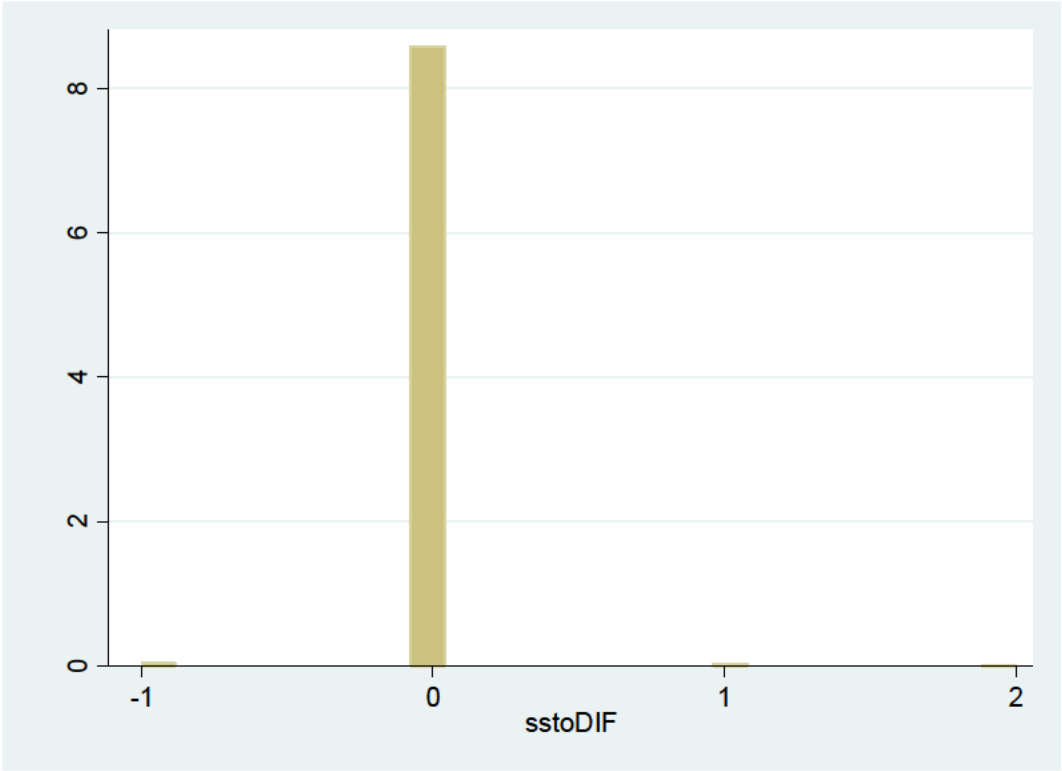
Value	Freq.	Percent
-2	1	0.14

	-1	25	3.52
	0	669	94.09
	1	16	2.25
Total	-11	711	100.00

SWINE (+1)

N = 711

Mean	Std. Err.	95% Conf. Interval
.0014	.0047	(-.0078, .0106)

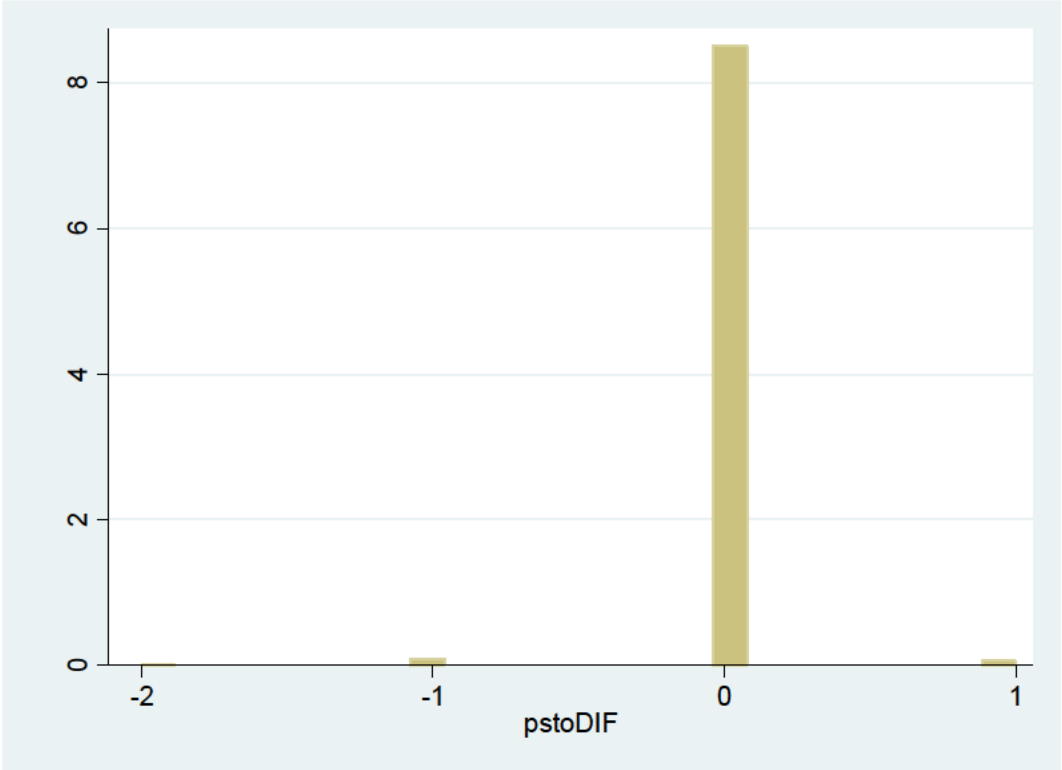


	Value	Freq.	Percent
	-1	4	0.56
	0	703	98.87
	1	3	0.42
	2	1	0.14
Total	+1	711	100.00

POULTRY (-5)

N = 711

Mean	Std. Err.	95% Conf. Interval
-.0070	.0058	(-.0184, .0043)



	Value	Freq.	Percent
	-2	1	0.14
	-1	8	1.13
	0	697	98.03
	1	5	0.70
Total	-5	711	100.00

Barnyard Runoff Control

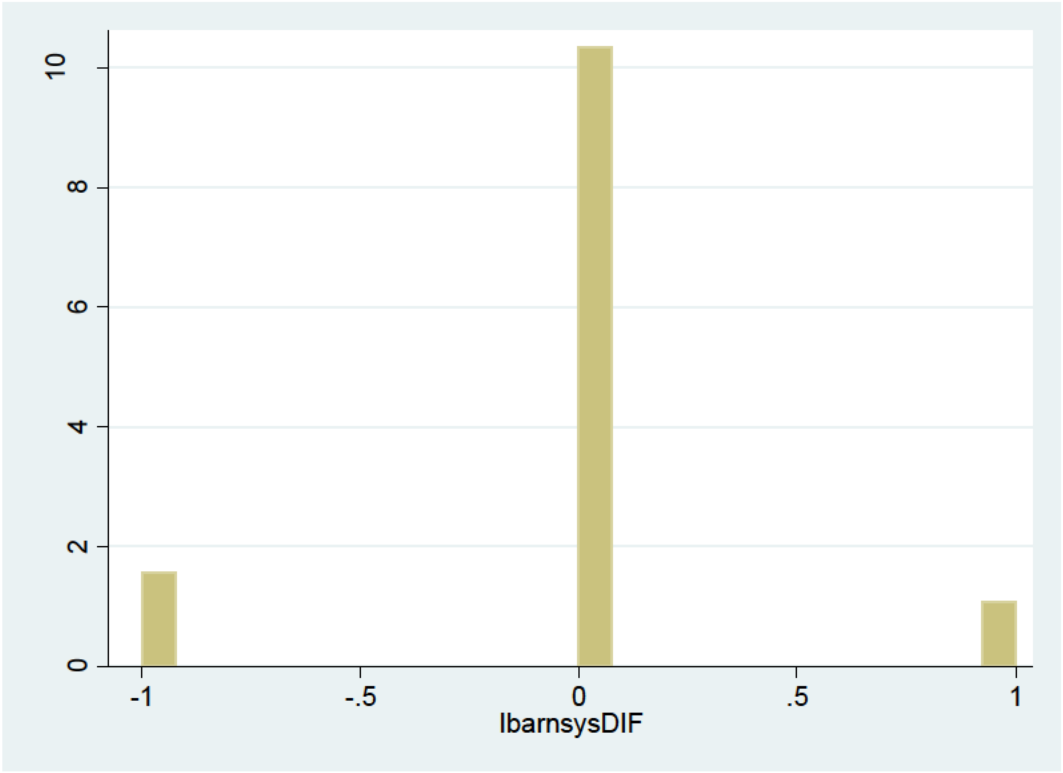
Difference between practices reported in mail/web survey and those reported from the farm visits

Farms having a privately funded barnyard runoff system overall:

N = 711

Mean	Std. Err.	95% Conf. Interval
-0.0380	0.0169	(-0.0711, -.0048)

On average about 4 percent of farms that did not report themselves having a system actually did have one as reported by the farm visits



Value	Freq.	Percent
-1	86	12.10

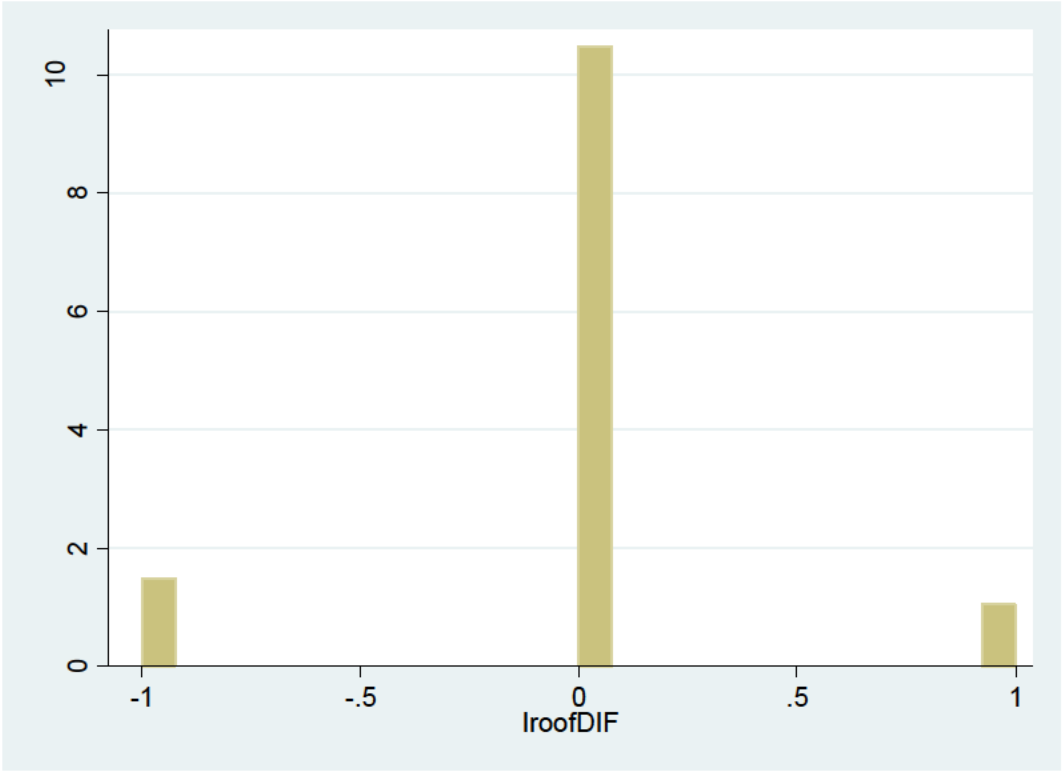
	0	566	79.61
	1	59	8.30
Total	-27	711	100.00

Reporting each practice within "Barnyard Runoff Control Structures" separately

ROOF RUNOFF STRUCTURES (-24)

N = 711

Mean	Std. Err.	95% Conf. Interval
-0.0328	0.0165	(-0.0661, -0.0014)

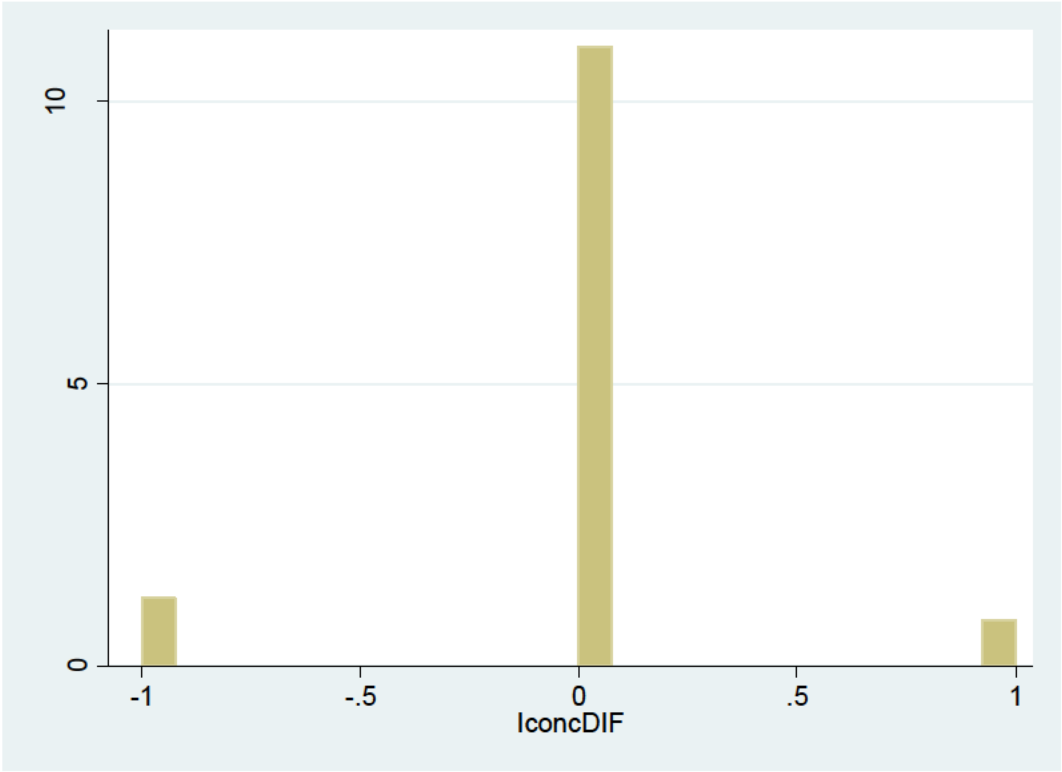


	Value	Freq.	Percent
	-1	81	11.39
	0	573	80.59
	1	57	8.02
Total	-24	711	100.00

CONCRETE BARNYARDS (-21)

N = 711

Mean	Std. Err.	95% Conf. Interval
-0.0295	0.0148	(-0.0586, -0.0005)

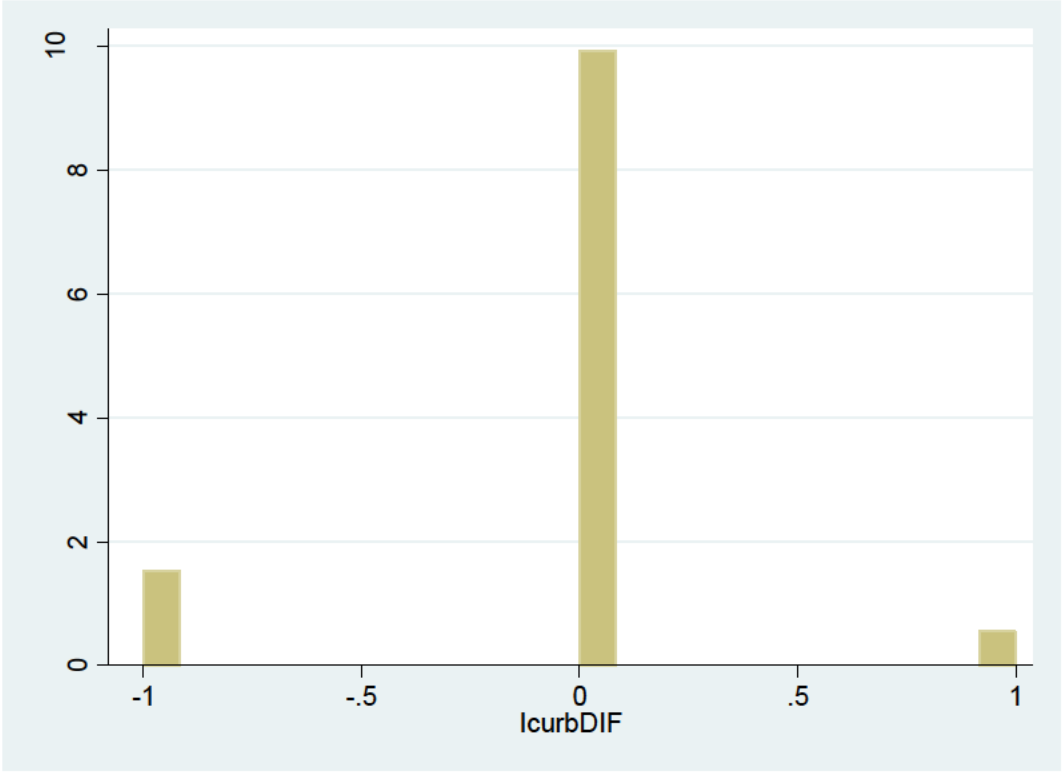


	Value	Freq.	Percent
	-1	66	9.28
	0	600	84.39
	1	45	6.33
Total	-21	711	100.00

CURBS (-57)

N = 711

Mean	Std. Err.	95% Conf. Interval
-0.0802	0.0151	(-0.1097, -0.0506)

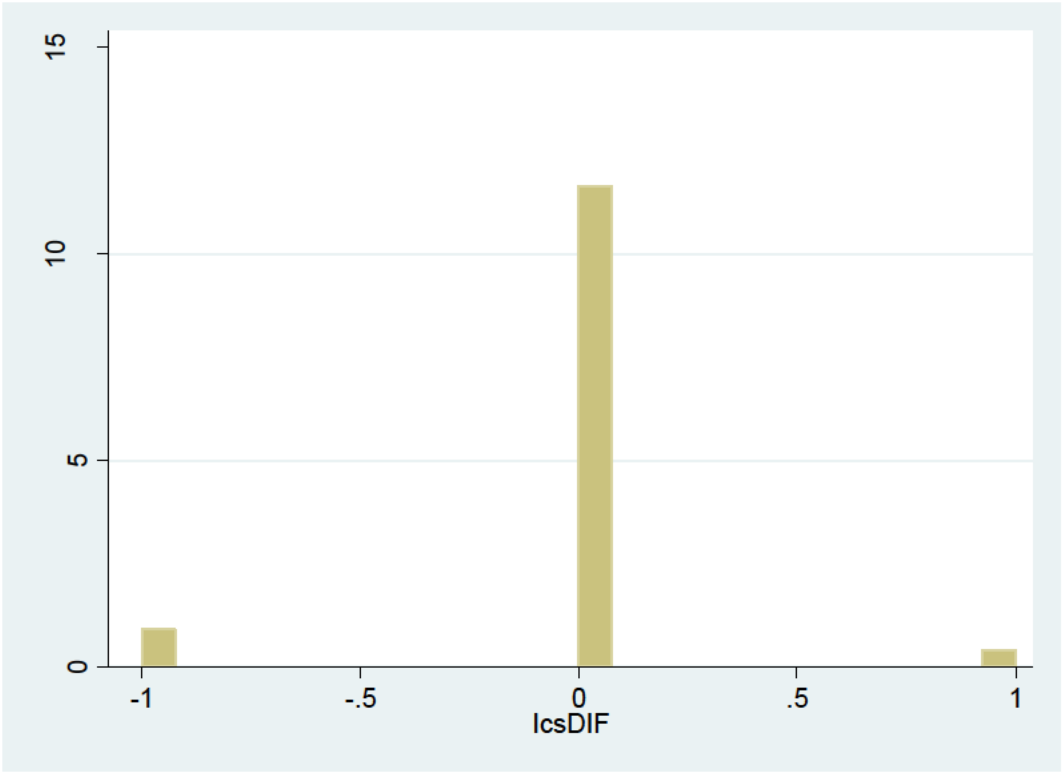


	Value	Freq.	Percent
	-1	88	12.38
	0	592	83.26
	1	31	4.36
Total	-57	711	100.00

COLLECTION SYSTEMS (-27)

N = 711

Mean	Std. Err.	95% Conf. Interval
-0.0380	0.0119	(-0.0614, -0.0145)

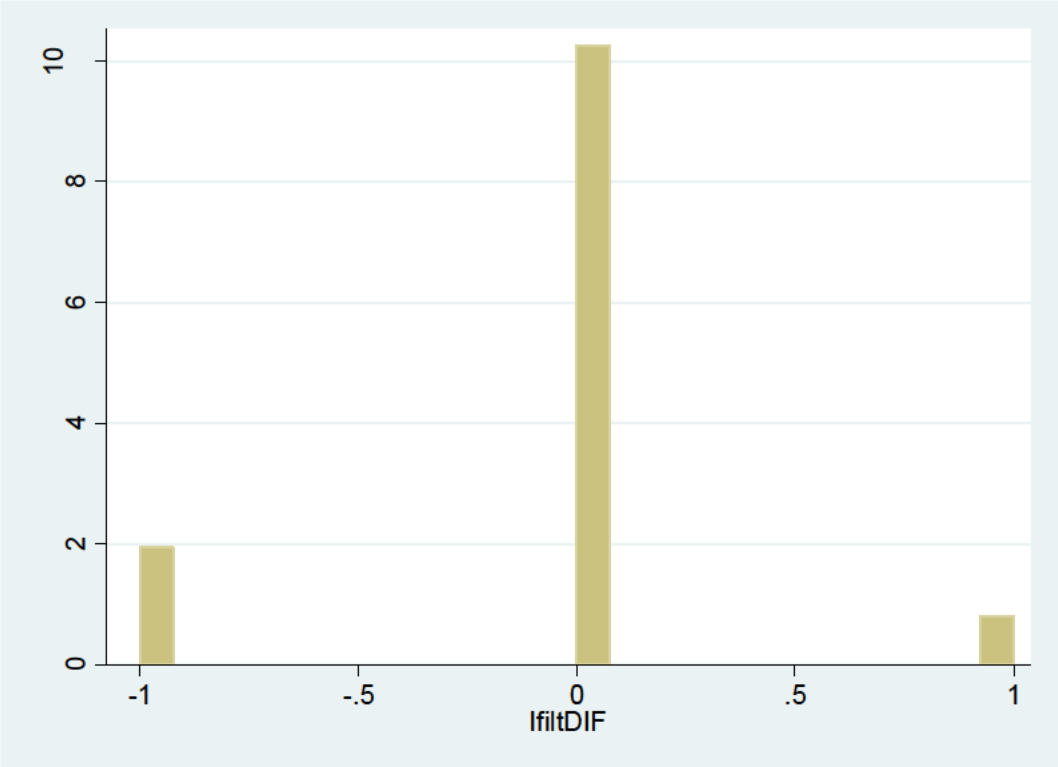


Value	Freq.	Percent
-1	50	7.03
0	638	89.73
1	23	3.23
Total -27	711	100.00

BARNYARD RUNOFF FILTER STRIPS (-62)

N = 711

Mean	Std. Err.	95% Conf. Interval
-0.0872	0.0169	(-0.1204, -0.0540)



Value	Freq.	Percent

	-1	106	14.91
	0	561	78.90
	1	44	6.19
Total	-62	711	100.00

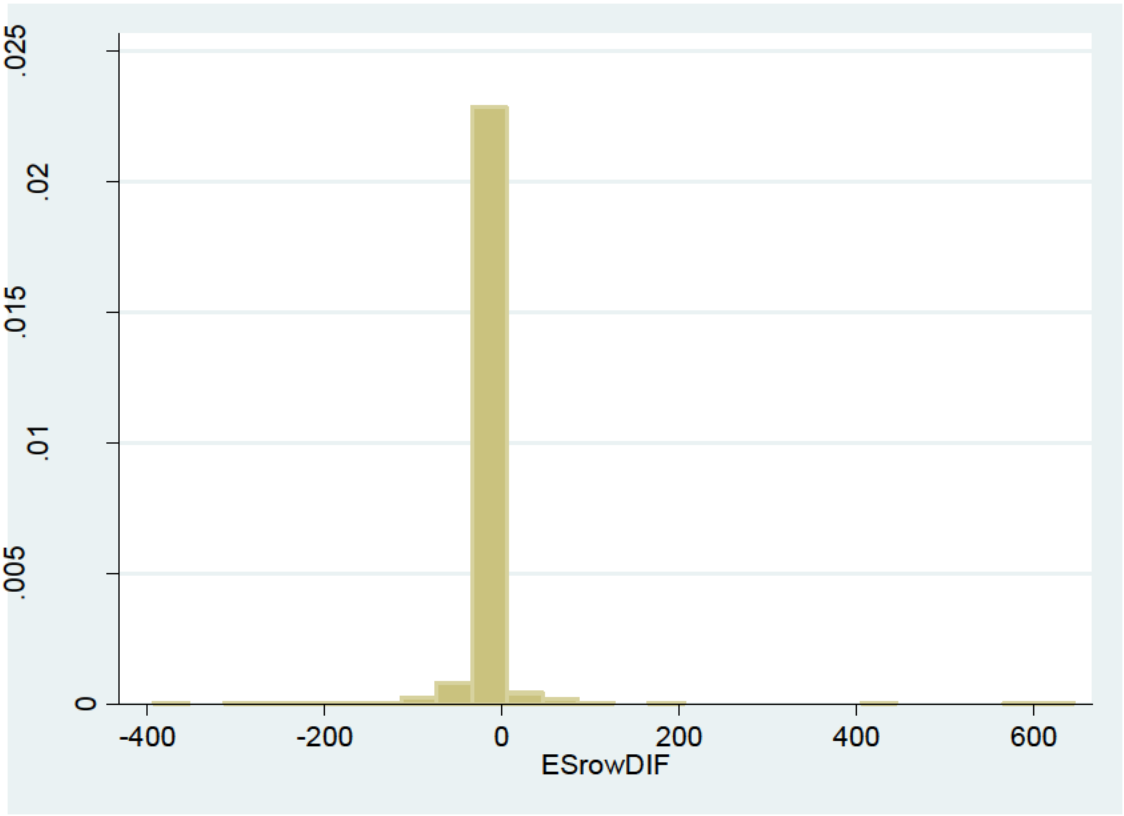
E&S Plans

ROW CROP ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
ESrowDIF	-2.98	2.40	(-7.69, 1.73)

Drop -1100	Mean	Std. Err.	95% Conf. Int.
ESrowDIF	-1.43	1.84	(-5.04, 2.18)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**622**	**87**	**0**	**---**	
Category 1	**18**	**3**	**130.64**	**47.61**	
Category 2	**49**	**7**	**-79.70**	**11.17**	
w/ -1100	50	7	-100.11	23.16	
Category 3	**21**	**3**	**25.64**	**13.99**	**(-3.53, 54.82)**
Total	**710**	**100**	**-1.43**	**1.84**	**(-5.04, 2.18)**
w/ -1100	711	100	-2.98	2.40	(-7.69, 1.73)



(graph excludes the -1100 observation)

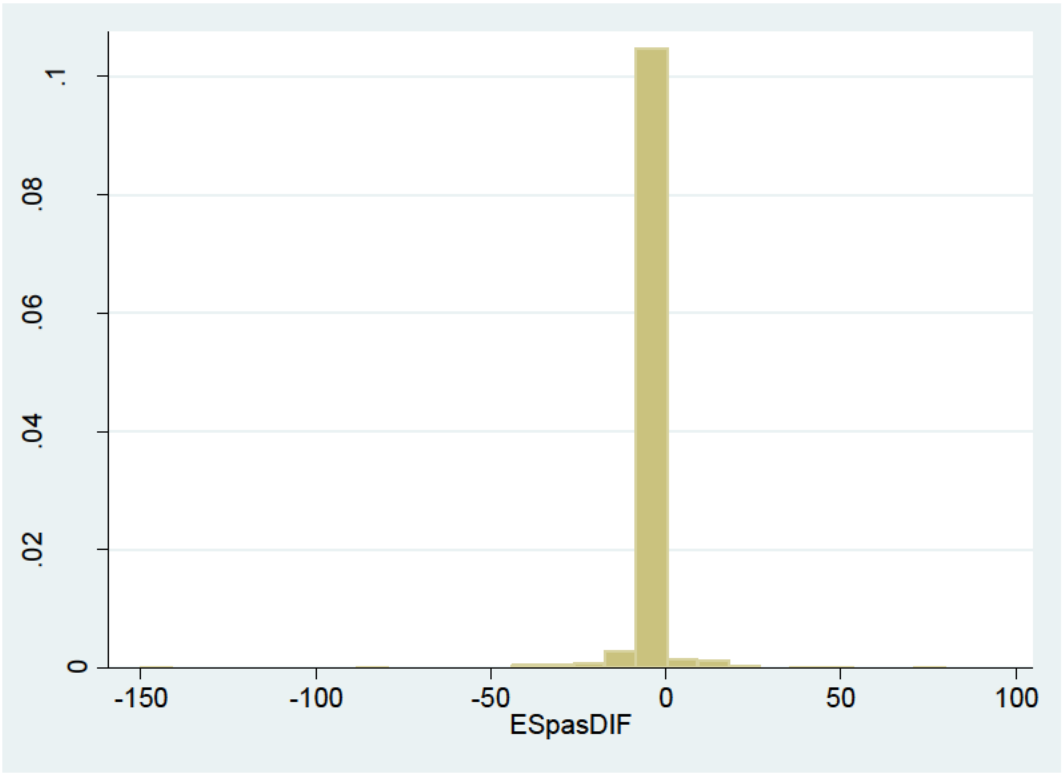
PASTURE ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
ESpasDIF	-1.20	0.65	(-2.48, 0.07)

Drop -400	Mean	Std. Err.	95% Conf. Int.
ESpasDIF	-0.64	0.33	(-1.28, -0.00)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**638**	**90**	**0**	**---**	
Category 1	**16**	**2**	**17.5**	**4.99**	
Category 2	**39**	**6**	**-19.75**	**4.19**	
w/ -400	40	6	-29.25	10.35	

Category 3	**17**	**2**	**2.02**	**2.55**	**(-3.41, 7.44)**
Total	**710**	**100**	**-0.64**	**0.33**	**(-1.28, -0.00)**
w/ -400	711	100	-1.20	0.65	(-2.48, 0.07)



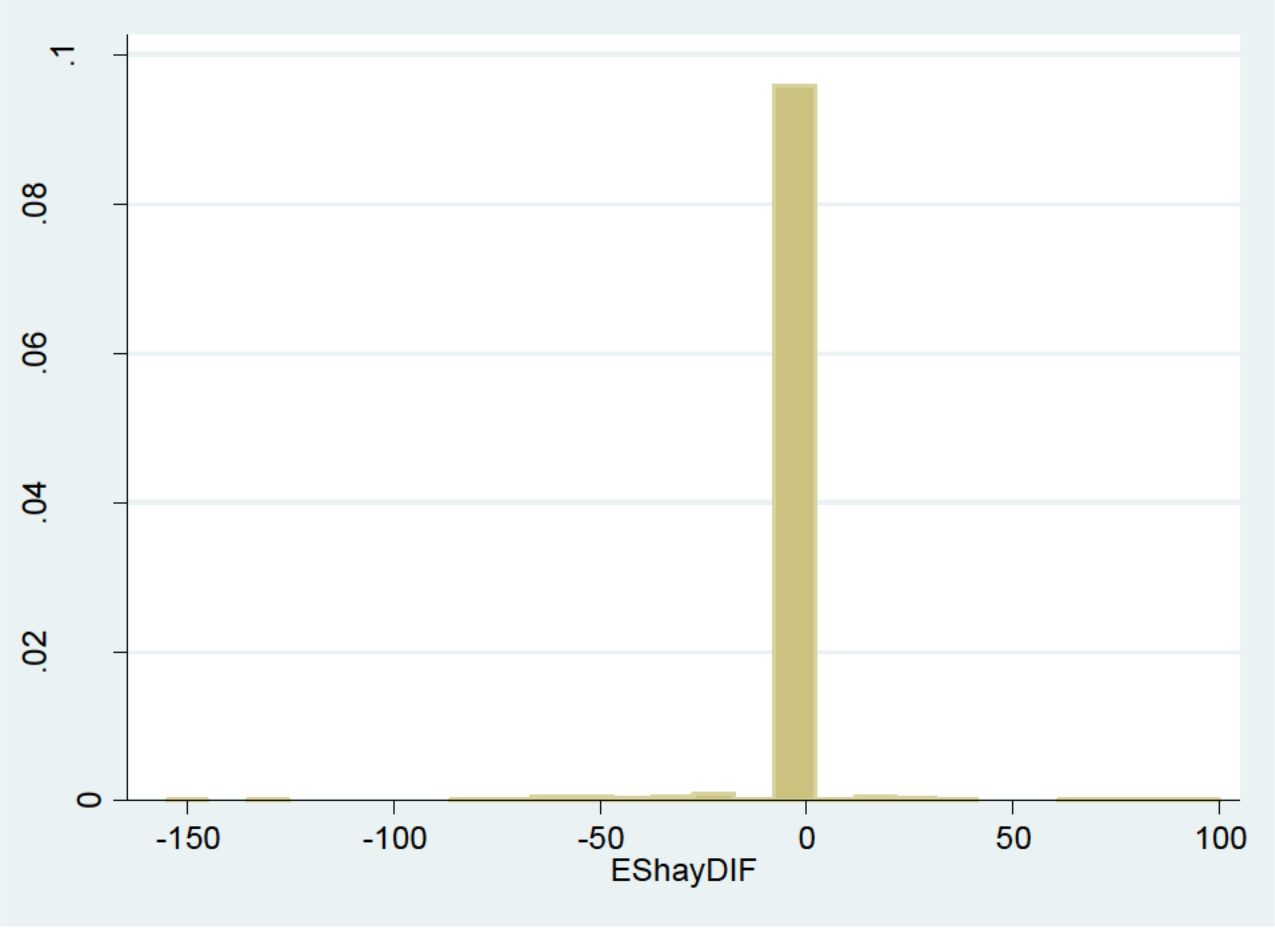
(graph excludes observation at -400)

HAY ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
EShayDIF	-2.44	0.95	(-4.30, -0.58)

Drop -400,-300,-278	Mean	Std. Err.	95% Conf. Int.
EShayDIF	-1.07	0.51	(-2.07, -0.07)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**644**	**91**	**0**	**---**	
Category 1	**12**	**2**	**44**	**8.17**	
Category 2	**37**	**6**	**-31.50**	**5.58**	
w/ outliers	40	6	-53.59	13.65	
Category 3	**15**	**2**	**-8**	**9.49**	**(-28.35, 12.35)**
Total	**708**	**100**	**-1.07**	**0.51**	**(-2.07, -0.07)**
w/ outliers	711	100	-2.44	0.95	(-4.30, -0.58)

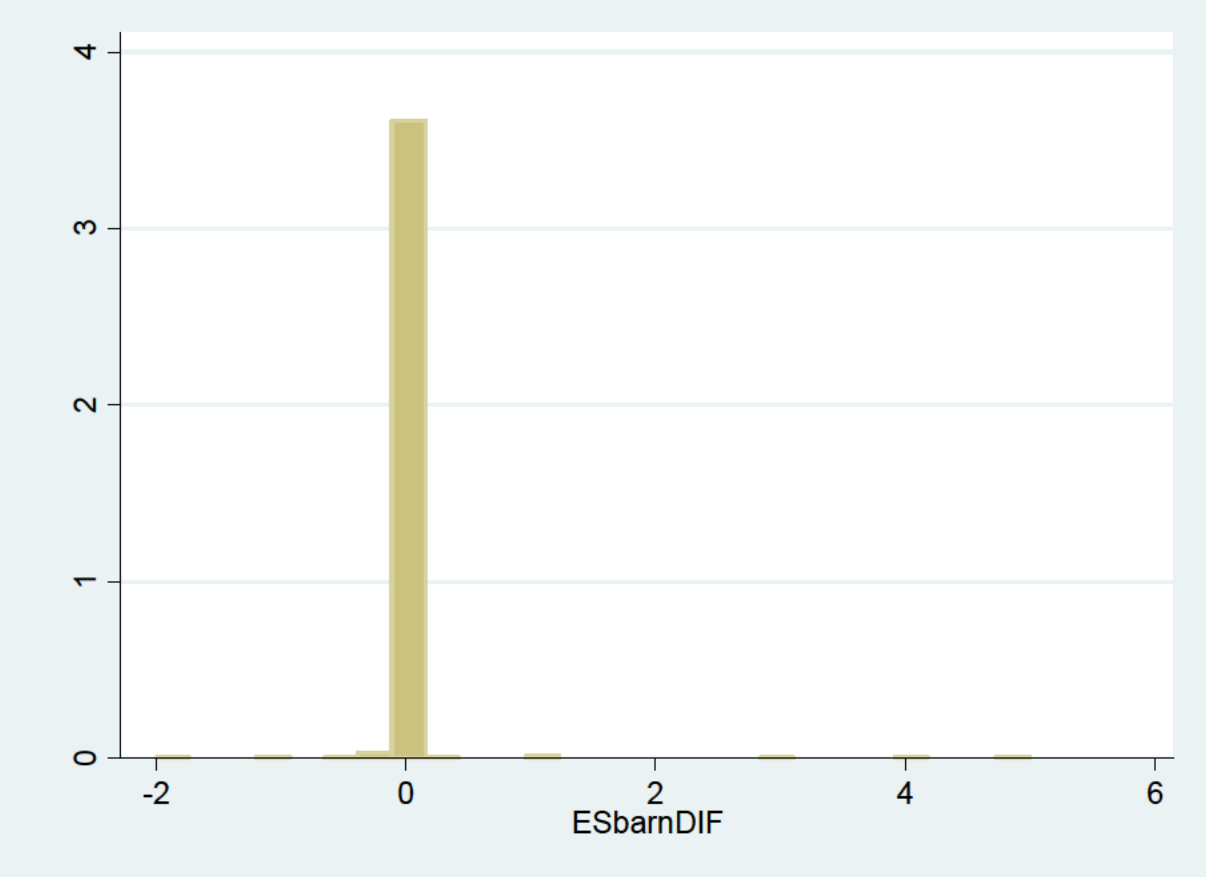


(graph excludes -400, -300, and -278)

BARNYARD ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
ESbarnDIF	0.025	0.014	(-0.002, 0.053)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**676**	**95**	**0**	**---**	
Category 1	**11**	**2**	**2.21**	**0.60**	
Category 2	**20**	**3**	**-0.31**	**0.11**	
Category 3	**4**	**1**	**0.01**	**0.16**	**(-0.51, 0.53)**
Total	**711**	**100**	**0.03**	**0.02**	**(-0.00, 0.05)**

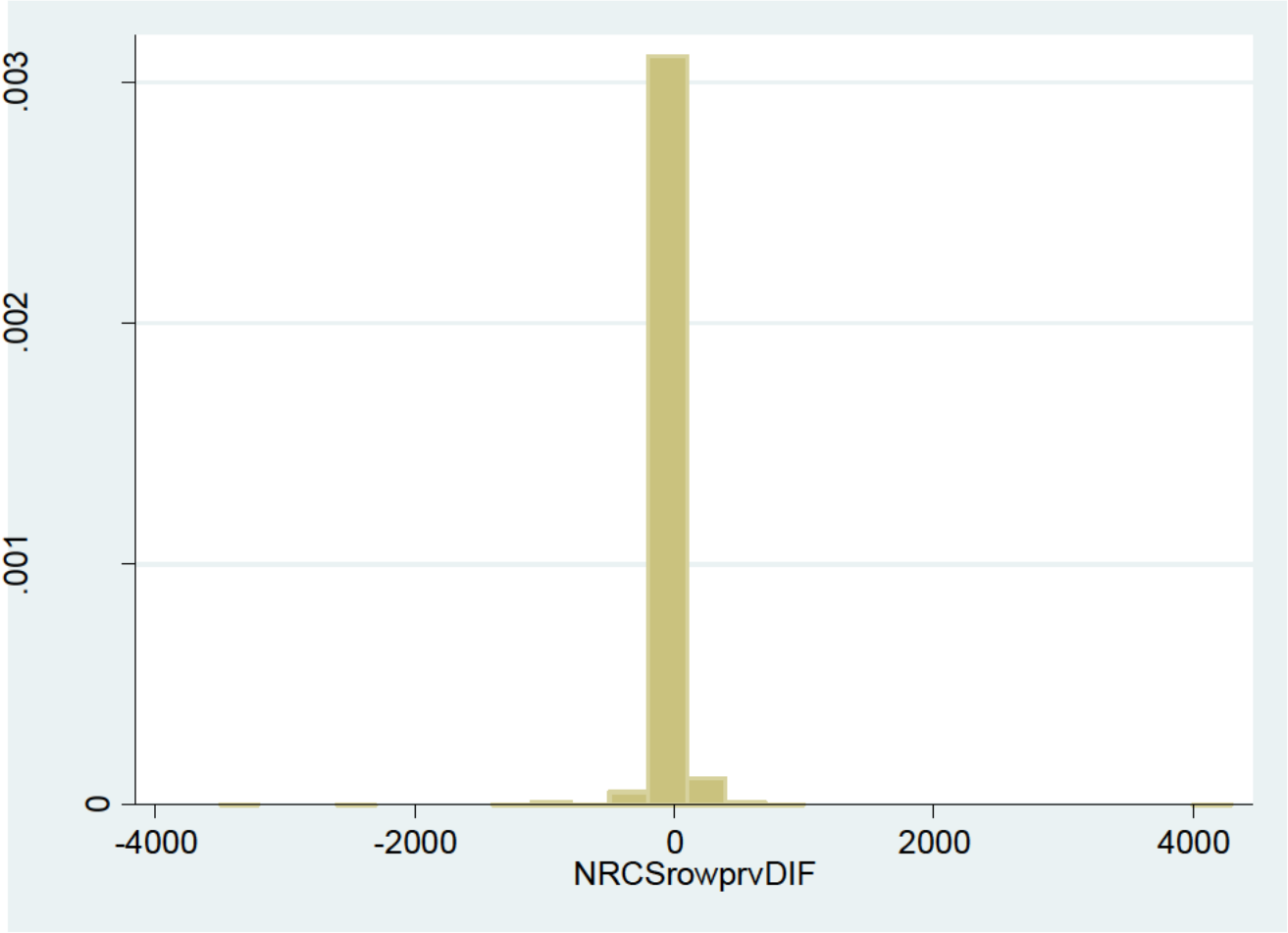


NRCS Plans (privately funded)

ROW CROP ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
NRCSrowprvDIF	-8.28	9.40	(-26.74, 10.19)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**538**	**76**	**0**	**---**	
Category 1	**55**	**8**	**128.48**	**18.84**	
Category 2	**77**	**11**	**-216.62**	**57.67**	
Category 3	**41**	**6**	**90.96**	**108.52**	**(-128.37, 310.28)**
Total	**711**	**100**	**-8.28**	**9.40**	**(-26.74, 10.19)**

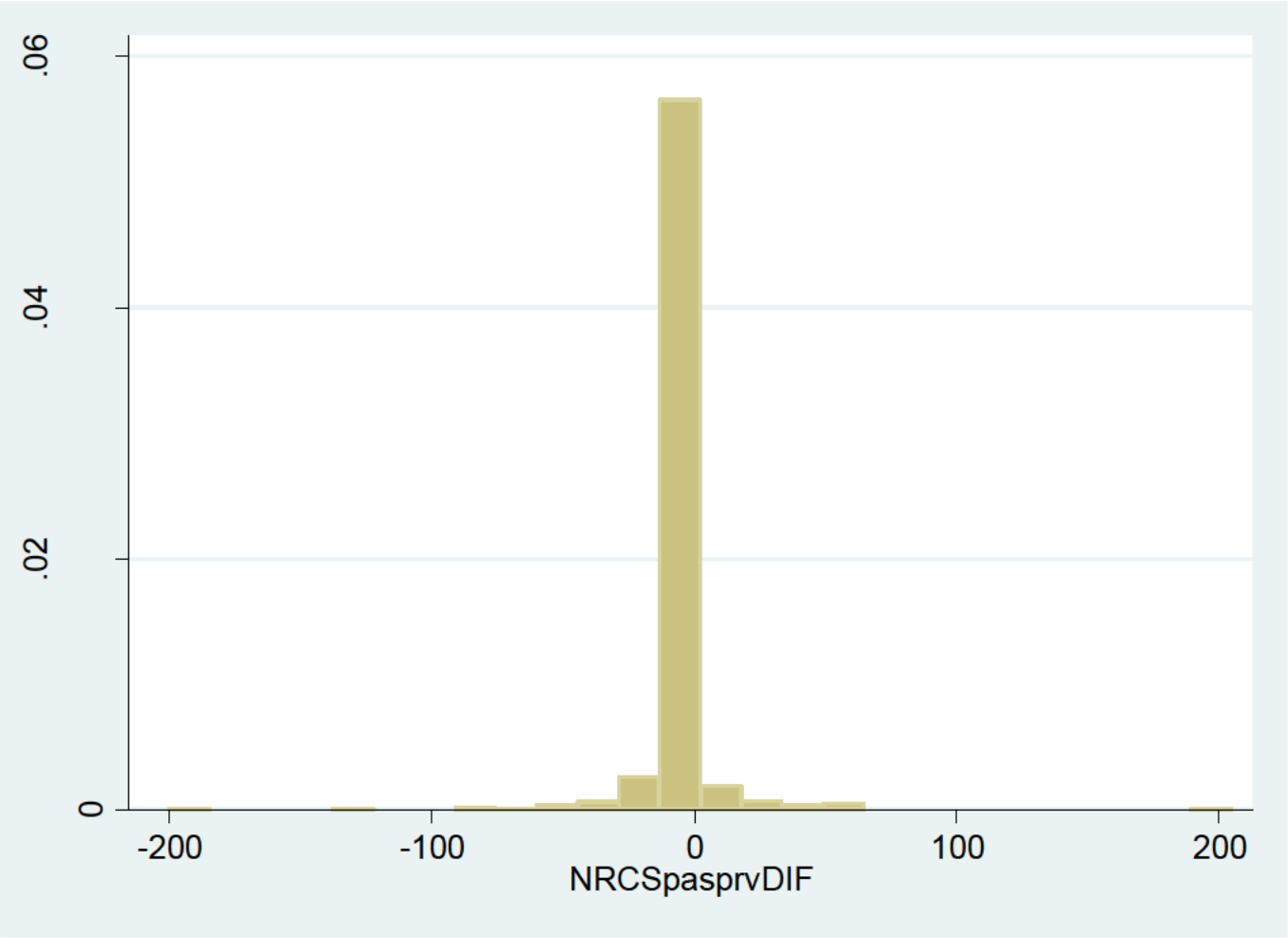


PASTURE ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
NRCSpasprvDIF	-0.97	0.59	(-2.13, 0.20)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**587**	**82.56**	**0**	**---**	
Category 1	**35**	**4.92**	**22.89**	**3.22**	
Category 2	**64**	**9.00**	**-24.08**	**3.71**	
Category 3	**25**	**3.52**	**2.12**	**9.63**	**(-17.75, 21.99)**

Total	**711**	**100.00**	**-0.97**	**0.59**	**(-2.13, 0.20)**



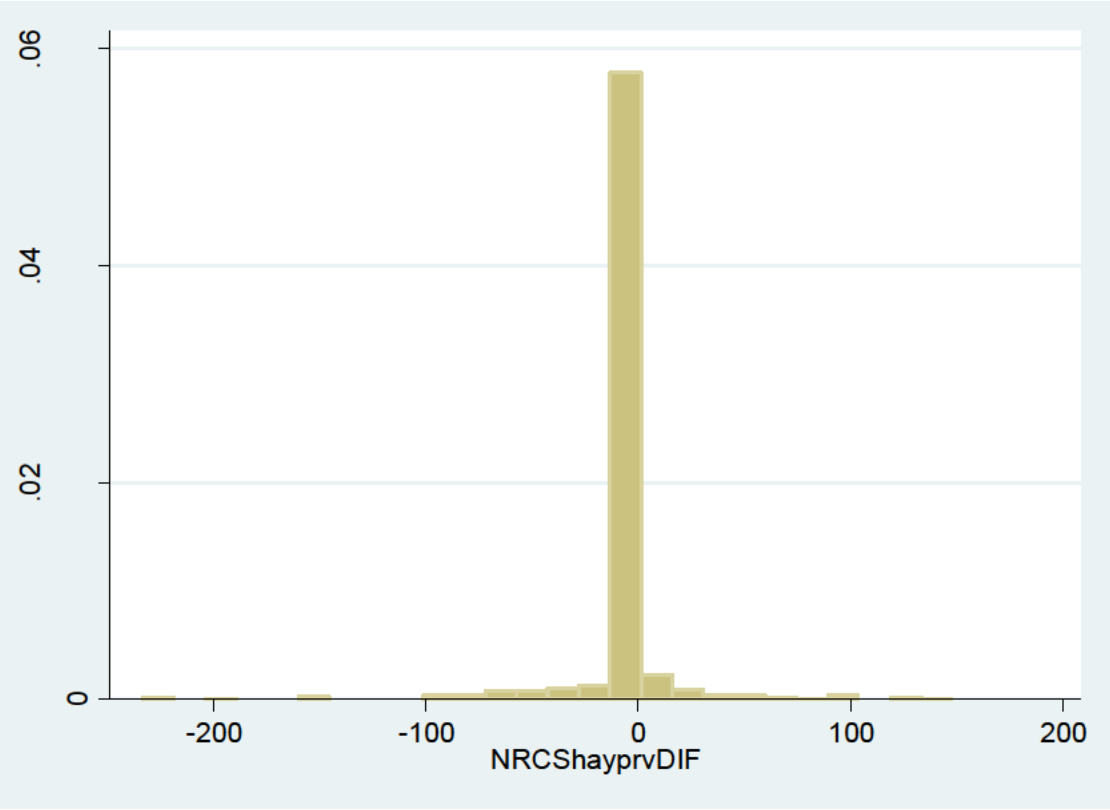
HAY ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
NRCShayprvDIF	-3.23	1.29	(-5.76, -0.69)

Drop -600	Mean	Std. Err.	95% Conf. Int.

NRCShayprvDIF	-2.39	0.98		(-4.31, -0.46)	

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**577**	**81**	**0**	**---**	
Category 1	**40**	**6**	**39.26**	**6.36**	
Category 2	**64**	**9**	**-46.72**	**5.56**	
w/ -600	65	9	-55.23	10.12	
Category 3	**29**	**4**	**2.12**	**9.63**	**(-17.75, 21.99)**
Total	**710**	**100**	**-2.39**	**0.98**	**(-4.31, -0.46)**
w/ -600	711	100	-3.23	1.29	(-5.76, -0.69)

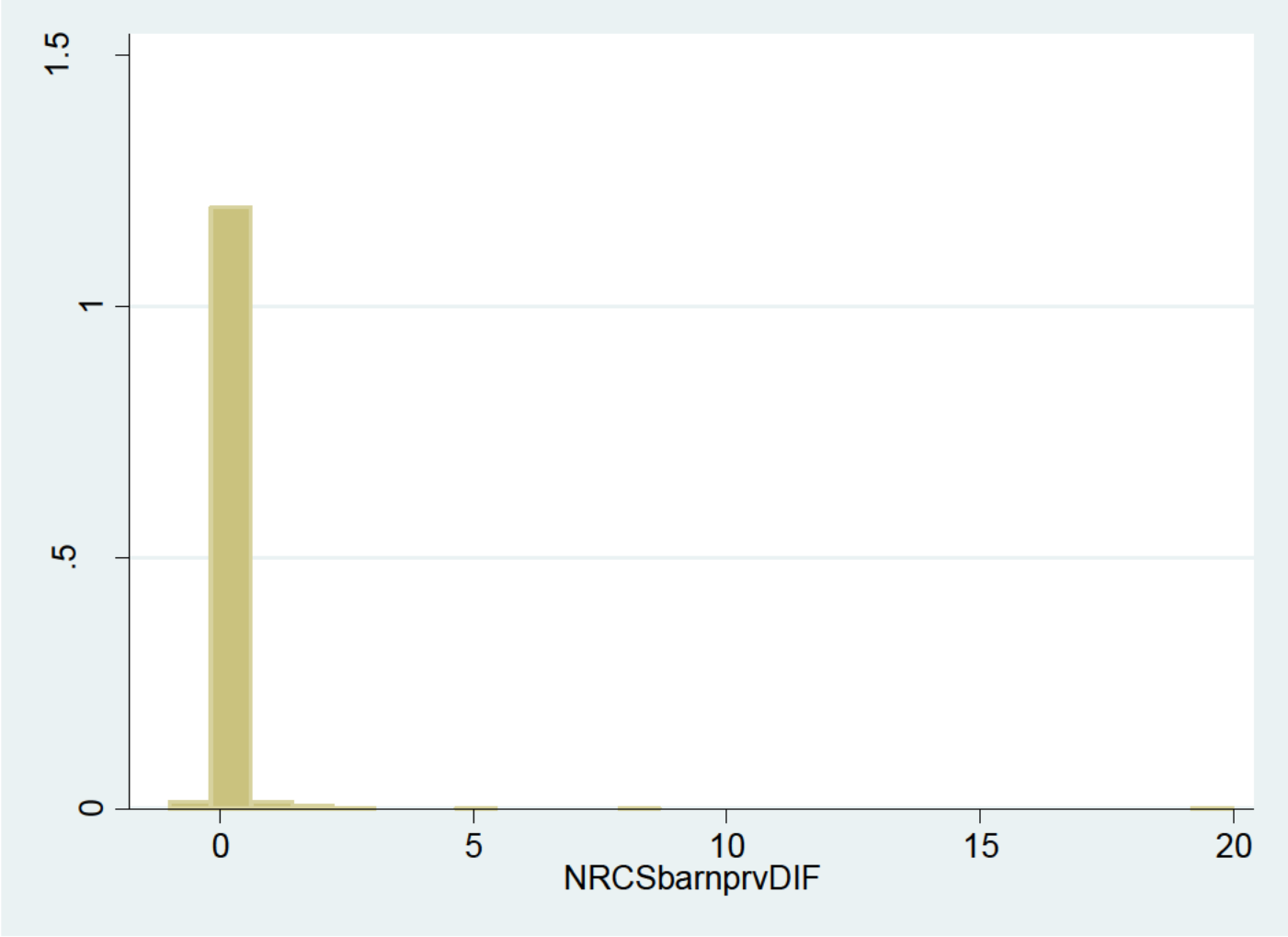


(graph excludes -600)

BARNYARD ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
NRCSbarnprvDIF	0.067	0.032	(0.004, 0.130)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**661**	**93**	**0**	**---**	
Category 1	**18**	**3**	**2.54**	**1.11**	
Category 2	**27**	**4**	**-0.19**	**0.04**	
Category 3	**5**	**1**	**1.39**	**0.93**	**(-1.21, 3.99)**
Total	**711**	**100**	**0.07**	**0.03**	**(0.00, 0.13)**



(graph excludes -600)

Stream Bank Fencing

FENCING LENGTH (FT.)

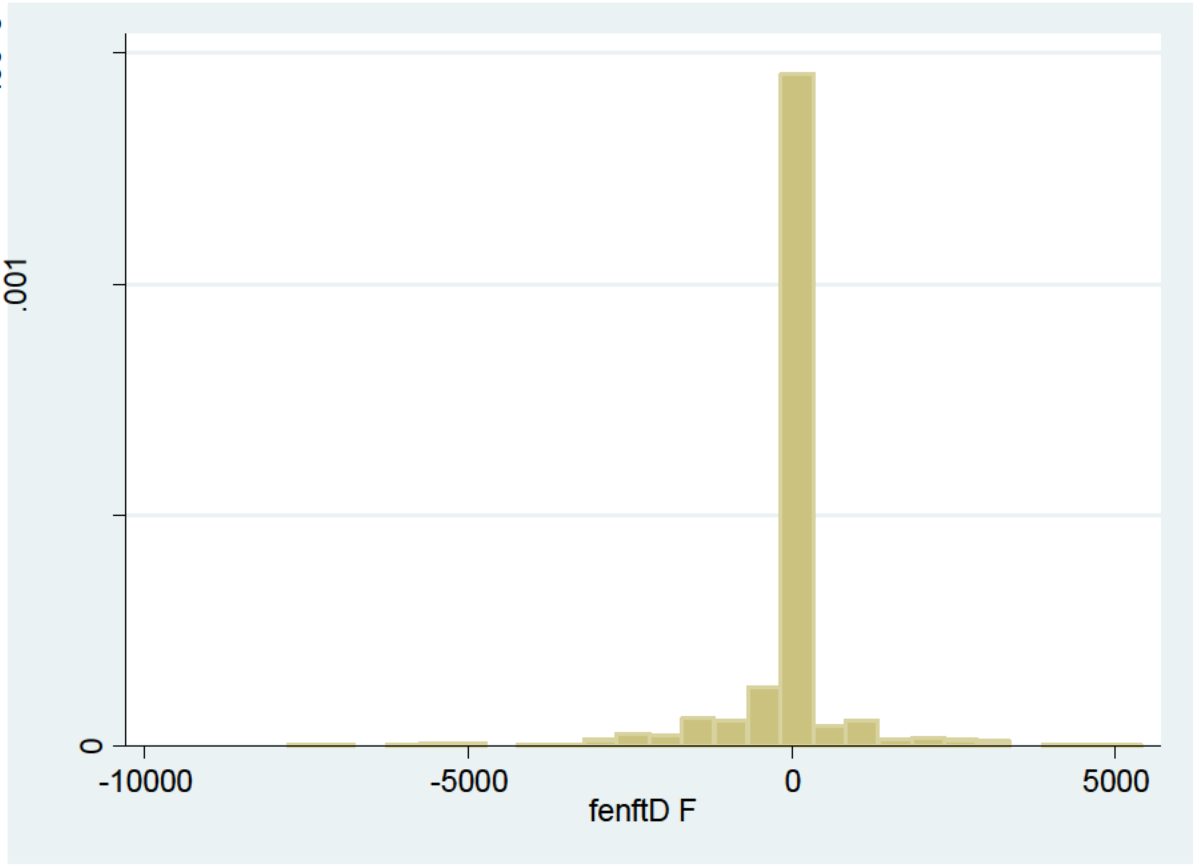
N = 711

Mean	Std. Err.	95% Conf. Interval
-204.376	60.428	(-323.015, -85.736)

Exclude 3 observations -25000, -17160, -11000

N = 708

Mean	Std. Err.	95% Conf. Interval
-130.157	40.489	(-209.650, -50.664)



(graph excludes -25000, -17160, and -11000)

		Freq.	Percent
reported 0	verified 0	478	67.23
reported > 0	verified 0	26	3.66
reported 0	verified > 0	61	8.58
reported > 0	verified > 0	146	20.53
	Total	711	100.00

DISTANCE FROM STREAM TO FENCE (FT.)

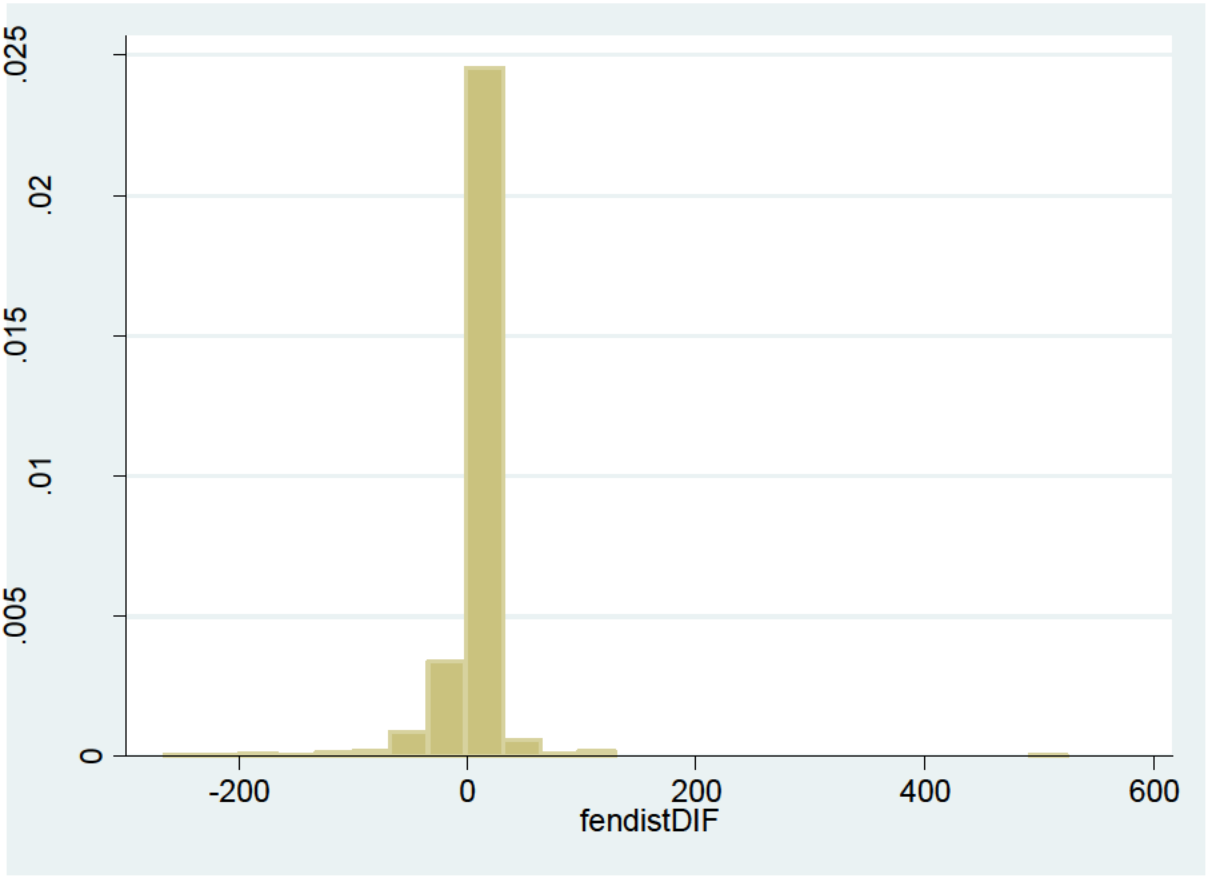
N = 711

Mean	Std. Err.	95% Conf. Interval
0.018	1.842	(-3.599, 3.635)

Exclude 1 obs +1000

N = 710

Mean	Std. Err.	95% Conf. Interval
-1.390	1.189	(-3.724, 0.945)



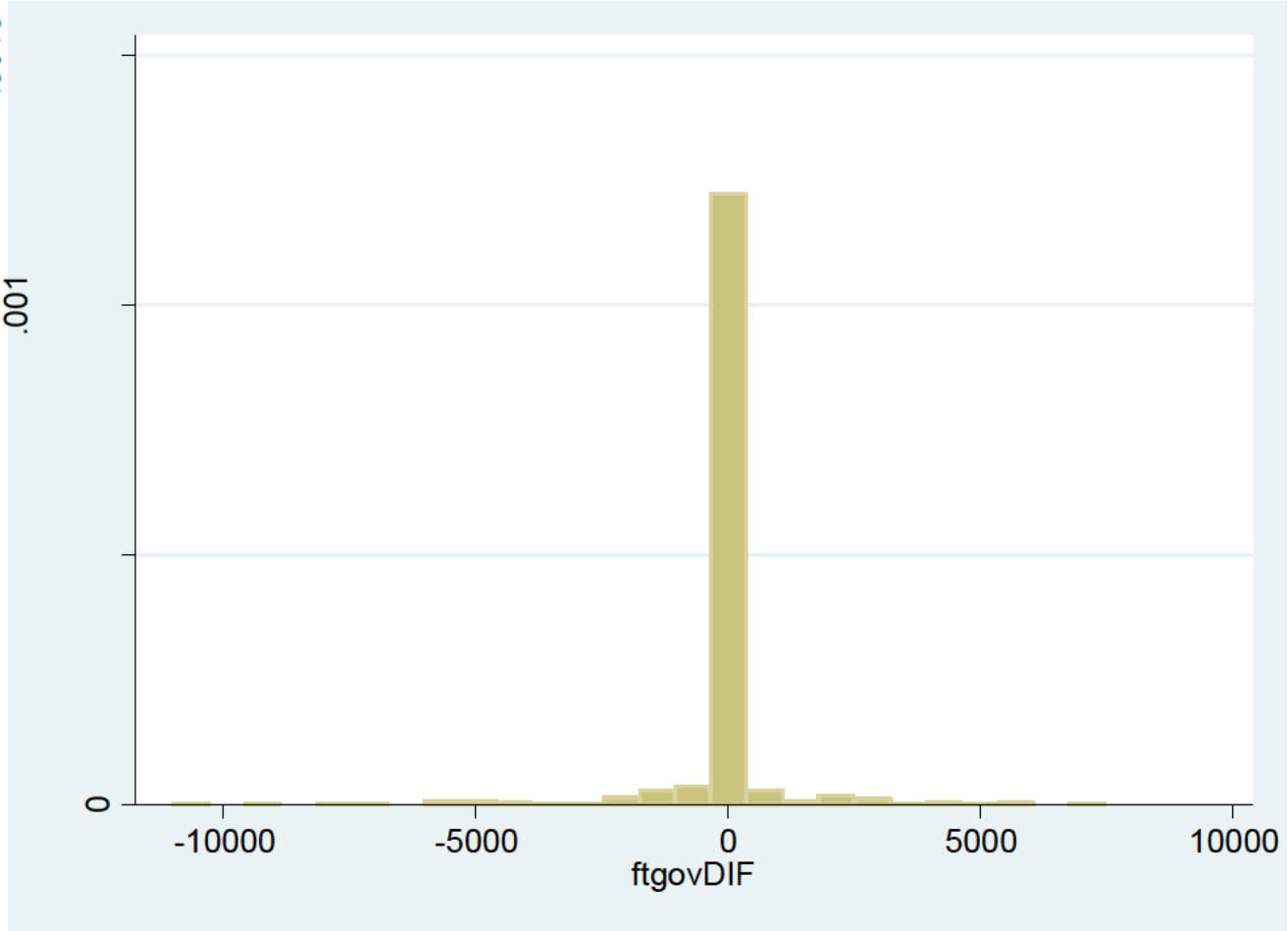
(graph excludes +1000)

			Freq.	Percent
reported	0	verified 0	471	66.24
reported	> 0	verified 0	35	4.92
reported	0	verified > 0	54	7.59
reported	> 0	verified > 0	151	21.24
		Total	711	100.00

PUBLIC FUNDED FENCING (FT.)

N = 711

Mean	Std. Err.	95% Conf. Interval
-64.471	43.189	(-149.265, 20.323)



		Freq.	Percent
reported 0	verified 0	599	84.25
reported > 0	verified 0	21	2.95
reported 0	verified > 0	28	3.94
reported > 0	verified > 0	63	8.86
	Total	711	100.00

PRIVATELY FUNDED FENCING (FT.)

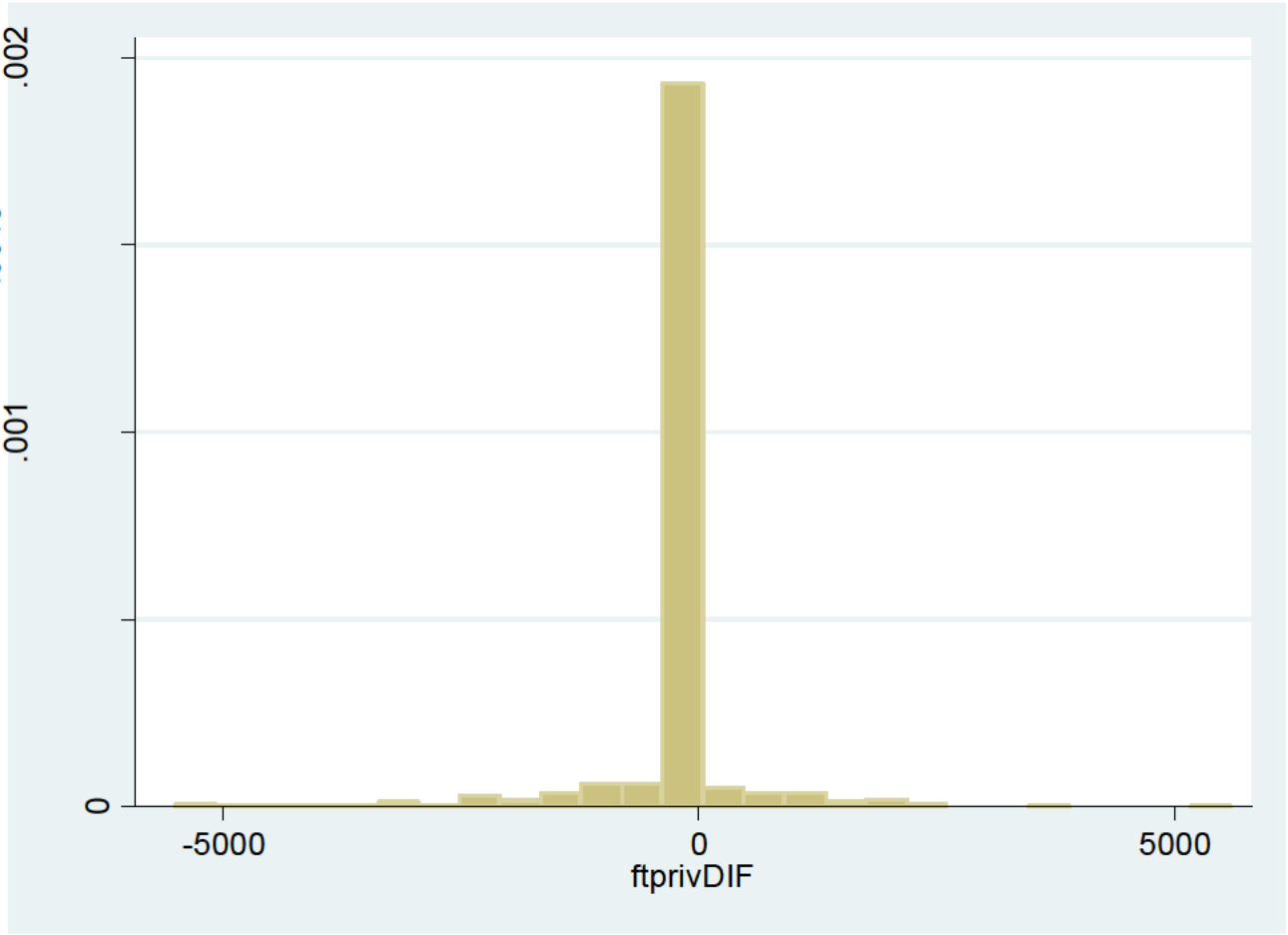
N = 711

Mean	Std. Err.	95% Conf. Interval
-141.190	52.784	(-244.822, -37.558)

Exclude 3 obs -25000, -17160, +10000

N = 709

Mean	Std. Err.	95% Conf. Interval
-96.364	28.078	(-151.491, -41.237)



(graph excludes -25000, -17160, +10000)

		Freq.	Percent
reported 0	verified 0	553	77.78
reported > 0	verified 0	29	4.08
reported 0	verified > 0	60	8.44
reported > 0	verified > 0	69	9.70
	Total	711	100.00

ACRES OF BUFFER (calculated with fence length x distance from stream)

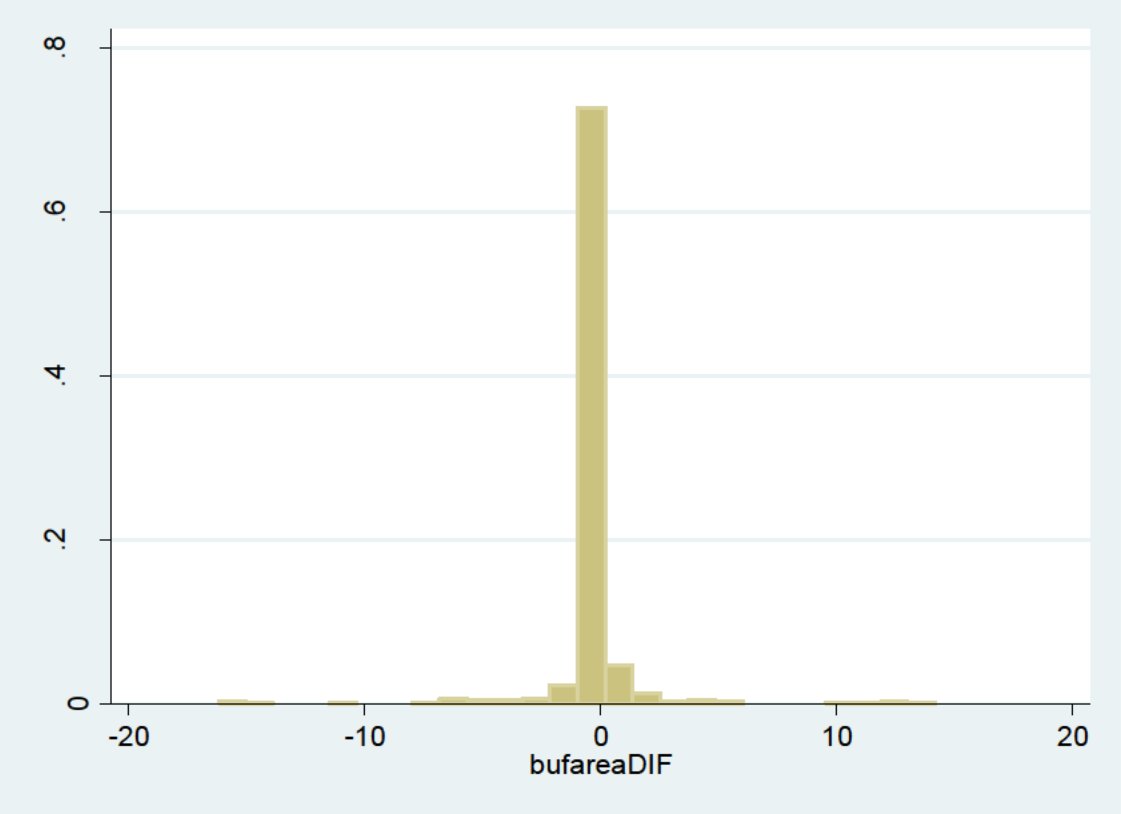
N = 711

Mean	Std. Err.	95% Conf. Interval
-0.215	0.099	(-0.409, -0.021)

Exclude 3 obs -39.39394, -27.77778, -19.66942

N = 708

Mean	Std. Err.	95% Conf. Interval
-0.093	0.067	(-0.225, 0.039)



(graph excludes -39.39, -27.78, -19.67)

		Freq.	Percent
reported 0	verified 0	478	67.23
reported > 0	verified 0	32	4.50
reported 0	verified > 0	61	8.58
reported > 0	verified > 0	140	19.69
	Total	711	100.00

ACRES OF PRIVATELY FUNDED BUFFER

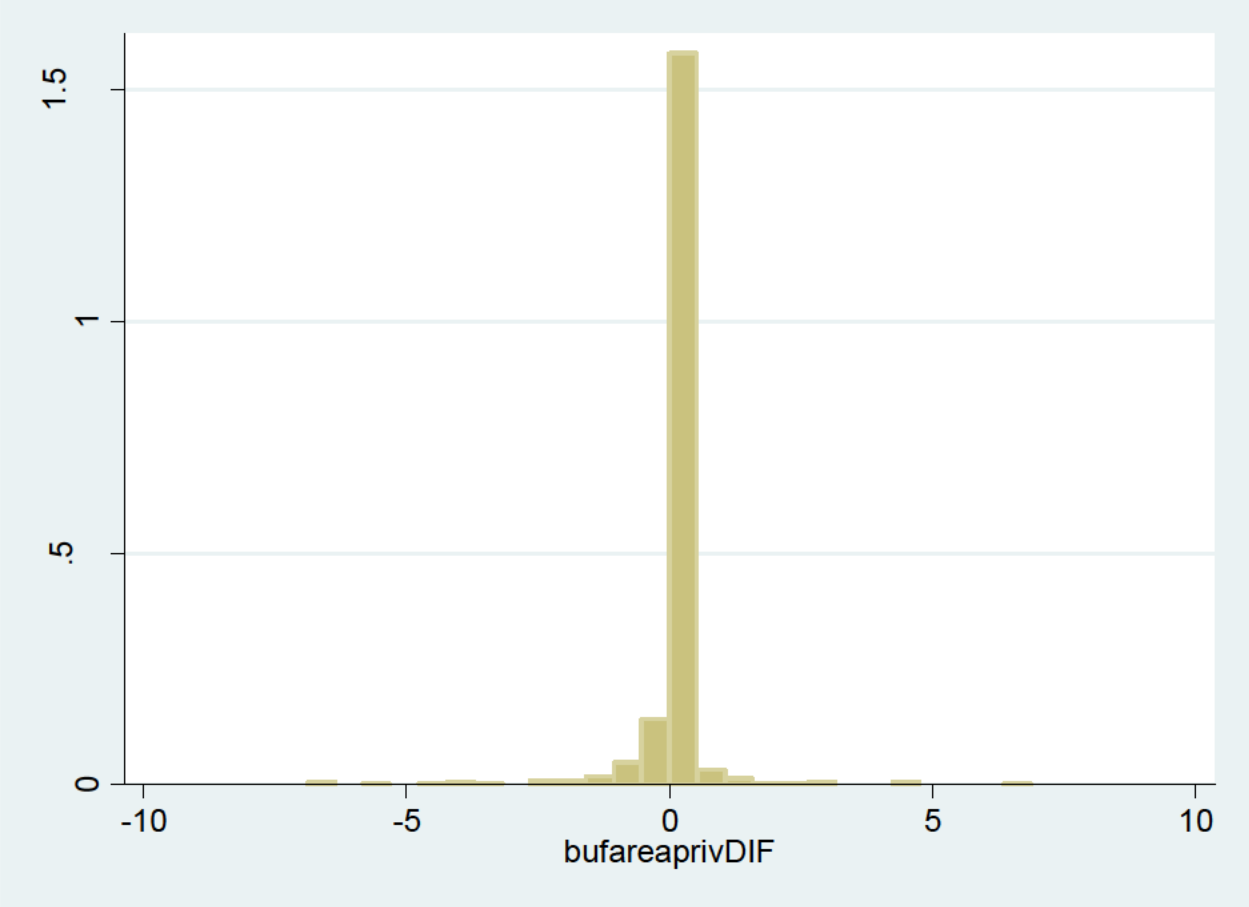
N = 711

Mean	Std. Err.	95% Conf. Interval
-0.142	0.067	(-0.273, -0.011)

Exclude 3 obs -39.39394, -14.63499, -10.56015

N = 708

Mean	Std. Err.	95% Conf. Interval
-0.051	0.027	(-0.105, 0.002)



(graph excludes -39.39, -14.63, -10.56)

		Freq.	Percent
reported 0	verified 0	555	78.06
reported > 0	verified 0	33	4.64

reported	0	verified > 0	58	8.16
reported > 0		verified > 0	65	9.14
		Total	711	100.00

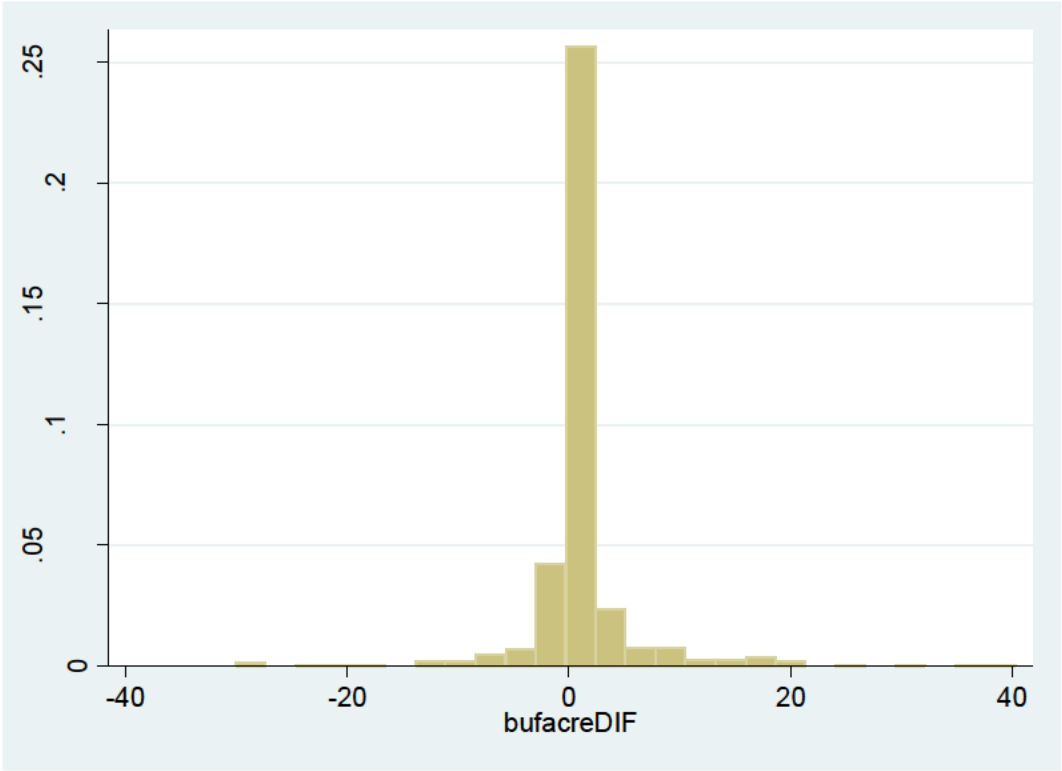
Riparian Buffers

This seems to be the only BMP that is systematically over-reported

BUFFER ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
bufacreDIF	0.514	0.262	(0.001, 1.028)
Drop -128.5583	Mean	Std. Err.	95% Conf. Int.
bufacreDIF	0.696	0.188	(0.326, 1.066)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**407**	**57**	**0**		
Category 1	**95**	**13**	**5.57**	**0.61**	
Category 2	**113**	**16**	**-2.84**	**0.45**	
w/-128.5583	114	16	-3.95	1.19	
Category 3	**95**	**13**	**3.01**	**0.92**	**(1.19, 4.83)**
Total	**710**	**100**	**0.70**	**0.19**	**(0.33, 1.07)**
w/-128.5583	711	100	0.51	0.26	(0.00, 1.03)

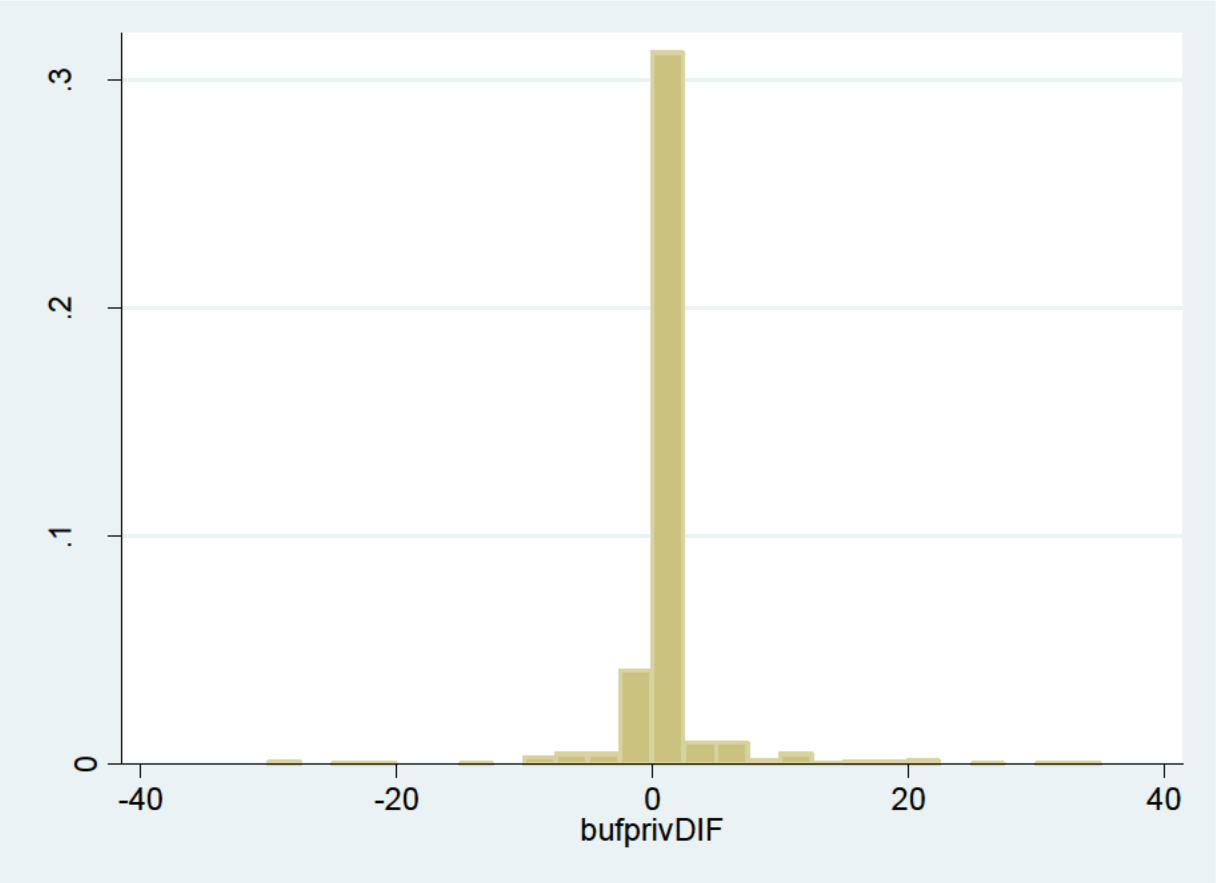


(graph excludes -128.5583)

PRIVATELY FUNDED BUFFER ACRES

Raw variable	Mean	Std. Err.	95% Conf. Int.
bufprivDIF	0.3308	0.1462	(0.0438, 0.6179)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.
Category 0	**509**	**72**	**0**		
Category 1	**80**	**11**	**5.54**	**0.71**	
Category 2	**87**	**12**	**-2.47**	**0.44**	
Category 3	**35**	**5**	**0.39**	**1.67**	**(-3.00, 3.79)**
Total	**711**	**100**	**0.33**	**0.15**	**(0.04, 0.62)**

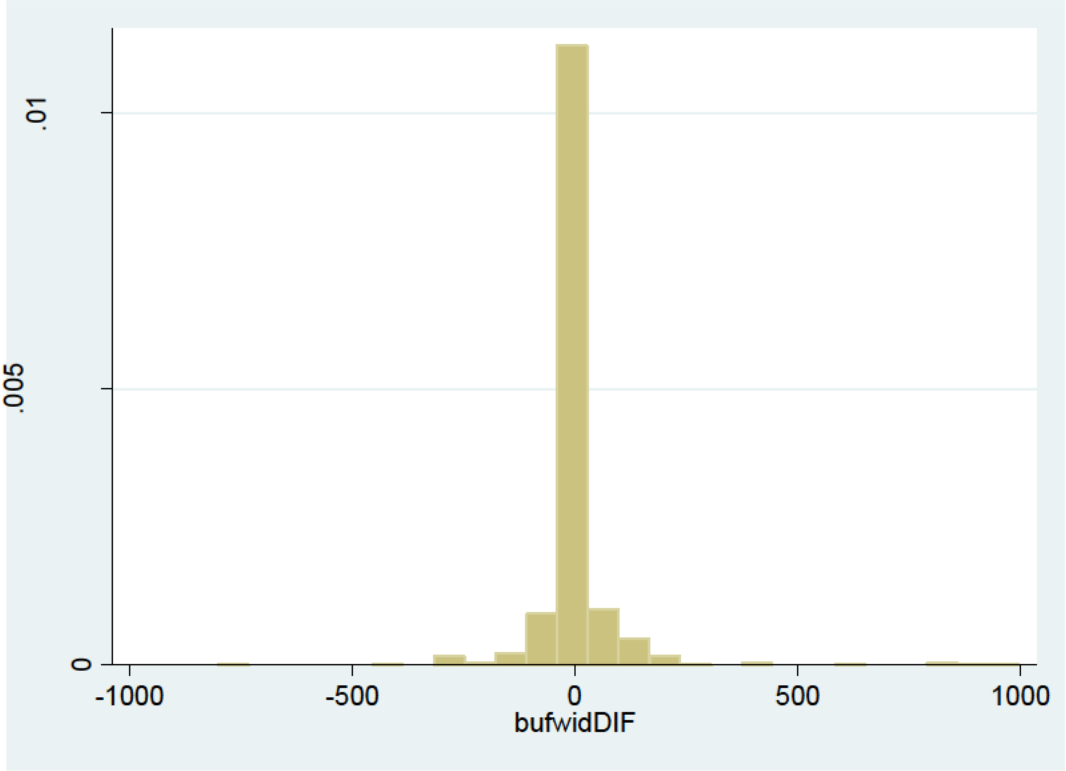


BUFFER WIDTH

Raw variable	Mean	Std. Err.	95% Conf. Int.
bufprivDIF	2.0499	4.6355	(-7.0510, 11.1509)
Drop -2000			
bufprivDIF	4.8697	3.6844	(-2.3640, 12.1034)

	Freq.	Percent	Mean	Std. Err.	95% Conf. Int.

Category 0	**398**	**56**	**0**		
Category 1	**98**	**14**	**89.89**	**14.69**	
Category 2	**110**	**16**	**-77.2**	**10.30**	
w/-2000	111	16	**-94.52**	**20.11**	
Category 3	**104**	**15**	**30.20**	**13.61**	**(3.21, 57.18)**
Total	**710**	**100**	**4.87**	**3.68**	**(-2.36, 12.1)**
w/-2000	711	100	2.05	4.64	(-7.05, 11.15)



(graph excludes -2000)

Appendix D: Summary Data on Manure Transport between Counties

Appendix E: Sample Calculation to Determine Expected (Adjusted) Acres and Upper and Lower 95% Confidence Limits for Aggregate Data

The per farm mean difference between reported and verified units and 95% confidence intervals established for each practice set forth in detail in Appendix C can be applied to the aggregate data to establish total "expected" results. This is done by applying the following calculation: reported value – mean deviation per farm*n, where n = total number of farms with survey returns (6,782). This same formula can be applied to calculate lower and upper 95% confidence bounds on this number by substituting the two ends of the 95% confidence intervals per farm for the mean deviation per farm developed for each practice.

These calculations allow "expected" results to be reported as adjusted results to account for systematic over or under reporting by respondents.

For example, the total aggregate riparian buffer acres reported from all survey returns (n=6,782) was 9,013 acres.

Reported Acres: 9,013 (for n 6,782) (p. 9, Table 1)

The verification data allows us to calculate per farm mean differences and upper and lower 95% confidence limits around this mean difference:

Verification Data: (for n=711) (p. 87, Appendix C, "Privately Funded Buffer Acres")
Mean Difference Per Farm (reported-verified): 0.3308
Std. Err. of Difference: 0.1462
Critical t-value: 1.96331
Lower 95% Confidence Limit of Difference: 0.0438 (calculated as follows: 0.3308-1.96331*0.1462 = 0.0438)
Upper 95% Confidence Limit of Difference: 0.6179 (calculated as follows: 0.3308+1.96331*0.1462 = 0.6179)

Applying these per farm calculations to the entire data set (n=6,782), we can developed "expected" aggregate riparian buffer acres and upper and lower 95% confidence intervals for the aggregate data as follows:

Expected (Adjusted) Acres: 6,770 (for n=6,782) (calculated as follows: reported value – mean deviation per farm*n, or 9,013-0.3308*6,782 = 6,770

Upper 95% Confidence Limit: 8,716 (for n=6,782) (calculated as follows: reported value – upper 95% confidence limit per farm*n, or 9,013-0.0438*6,782 = 8,716

Lower 95% Confidence Limit: 4,823 (for n=6,782) (calculated as follows: reported value – upper 95% confidence limit per farm*n, or 9,013-0.6179*6,782 = 4,823

This allows us to report 6,770 acres of riparian buffers as adjusted results to account for systematic over reporting of the practice.